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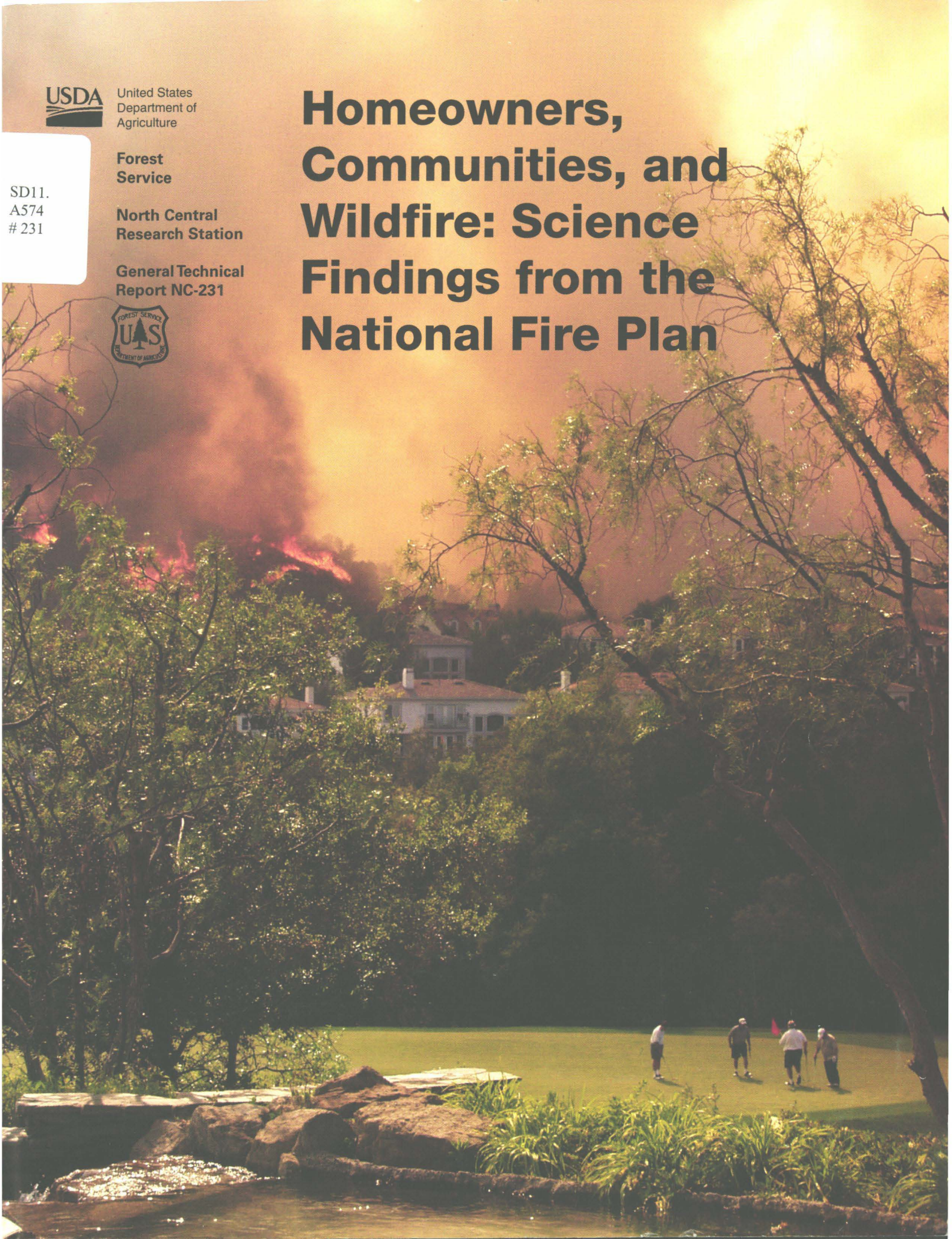
Homeowners, Communities, and Wildfire: Science Findings from the National Fire Plan



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Homeowners, Communities, and Wildfire: Science Findings from the National Fire Plan

Proceedings of the Ninth International Symposium on Society and Resource Management

Bloomington, Indiana
June 2-5, 2002

Pamela J. Jakes, Compiler

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FOREWORD

The Ninth International Symposium on Society and Resource Management (ISSRM) was held on the campus of Indiana University in Bloomington, Indiana, June 2-5, 2002. Since 1986, ISSRM has convened biennially to bring together natural resource managers and social scientists in discussions and demonstrations of how social science can improve resource management decision-making.

The Ninth ISSRM provided one of the first opportunities to bring together managers and social scientists conducting research or developing projects supported by the National Fire Plan. The National Fire Plan was a response by Federal land management agencies, States, and local communities to the devastating fires of the last decade. The goal of the National Fire Plan is to reduce the impact of wildfires on rural communities and ensure sufficient firefighting capacity in the future through research, management, and community assistance. The theme of the Ninth ISSRM, "Choices and Consequences: Natural Resources and Societal Decision-Making," was especially germane to wildfire as we now respond to the consequences of wildfire management choices made decades ago. More than 15 papers related to the human dimensions of wildfire were presented at the symposium. In addition to these scientific exchanges, social events and informal networking sessions encouraged discussions of how these individual projects come together to begin to tell a story of people, communities, and wildfire.

Our thanks to the Symposium Co-chairs Alan Ewert and Daniel McLean, Symposium Coordinator Alison Voight, and the participants who made this meeting possible.

Pamela Jakes
Wildfire Sessions Organizer

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PEOPLE AND WILDFIRE: AN OVERVIEW

Anne P. Hoover[1] and Linda L. Langner[2]

Recent catastrophic wildfires across the United States have focused public attention on the social and economic impacts of fire. Homes in the wildland-urban interface consumed by flames, families left homeless, and communities overwhelmed by smoke, and the heavy economic burdens of fire and its aftermath are memories not soon forgotten. As more people choose to live in regions of the country where fire-prone vegetation is dominant, the challenge of managing ecosystems and people to reduce fire risk grows with each fire season. Clearly, reducing the threat of wildfire requires understanding both the biophysical and human social systems that contribute to fire risk.

In recent years, the fire management community has begun to recognize the need for research findings from the scientific disciplines that study human behavior, institutions, and culture—the social sciences—to help solve many of today's critical wildfire issues. This became evident after the devastating fires of 2000 when, at the request of then President Clinton, Federal land management agencies, in cooperation with the States and local communities, developed a National Fire Plan to help reduce the impact of wildfires on rural communities and ensure sufficient firefighting capacity in the future. The National Fire Plan addresses four key areas: Firefighting Capacity, Rehabilitation and Restoration, Hazardous Fuel Reduction, and Community Assistance. Under this Plan, agencies are directed to develop a long-term program of research, including social science research, to support fire managers' efforts to manage and fight wildfire.

During the first year of National Fire Plan funding, Forest Service research scientists received $26 million for 63 new projects. Approximately $4 million of these funds were spent on projects related to the social and economic dimensions of wildfire. Much of this social science research is being conducted collaboratively with universities, non-governmental organizations, and other cooperators across the country. The Joint Fire Sciences Program and the National Science Foundation have also funded social science research related to fire.

Concurrently with the National Fire Plan efforts, the National Wildfire Coordinating Group (NWCG) commissioned a report[3] in 2001 to describe the applicability of social science to fire management problems and to articulate high priority needs for social science research related to fire. Priority research areas identified in the report include human variables as contributing factors to wildland fire; socioeconomic impacts of wildland fire; firefighter health and safety; public health and safety related to wildland fire; organizational capacity, decisionmaking, and coordination; public values, attitudes, and behaviors; and pathways of public communication related to wildland fire. Recently, an interagency team of researchers and fire managers was created to build and implement a social science research agenda as a followup to this report.

In response to expanding interest and Federal support for social science and fire research, a series of papers was presented at a session entitled "Human Dimensions Research and the National Fire Plan" during the nineth International Symposium on Society and Resource Management at Indiana University, Bloomington, Indiana,

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[3] Machlis, Gary E. and others. 2002. Burning questions: a social science research plan for Federal wildland fire management. Report to the National Wildfire Coordinating Group. Moscow, ID: University of Idaho, College of Natural Resources, Idaho Forest, Wildlife and Range Experiment Station.

June 2-5, 2002. Initial findings from selected session papers are presented here in these proceedings. This research was conducted by Forest Service social scientists and their cooperators and is supported by the National Fire Plan, the Joint Fire Sciences Program, and the National Science Foundation.

The first set of papers covers a range of research priorities and methods, but all these papers have in common an interest in public views about fire and fire management activities. Condie and Raish emphasize that knowledge of historic use of fire by indigenous and traditional communities serves as an important context for understanding fire management views currently held by these communities. The authors follow with an overview of past uses of managed fire by American Indian, Hispanic, and Anglo-American communities in the Southwestern U.S. In addition, they discuss common uses across cultural groups and the potential for landscape-scale environmental effects due to fire.

Bright and others; Winter; and Hendricks and others focus on public perceptions and beliefs about wildfire management. Bright and his co-authors develop measurement scales for basic beliefs about wildfire management of public land visitors in three states. Hendricks and others surveyed visitors to Big Sur about their observations of fire management actions, such as restricting use of campfires and closing areas, and the effects on visit quality. Their study also tested whether place attachment is a useful concept for segmenting visitors. Winter assesses public attitudes and values about fire and fire management. She finds that trust is an important predictor of effectiveness and approval ratings concerning fire management techniques.

Several papers address homeowner perceptions and attitudes about fire and the implications of these for public education. In the work by Daniel and others, members of the public easily learned to perceive fire hazard associated with certain vegetation types, but did not always choose actions that minimize risk because of preferences for aesthetic values. In another case, Vogt and others found that homeowner attitudes about fuel treatment methods varied geographically and depended on trust in government and on personal importance of each fuel treatment. A second paper by Vogt evaluates past experiences of seasonal and permanent homeowners with different fuel reduction techniques. She found differences between seasonal and permanent residents, as well as geographic differences. The study by Nelson and others documents homeowner preferences regarding possible actions to be taken to prevent wildfires. These papers illustrate how knowledge of homeowner experiences and attitudes can help managers work with communities to reduce the risk of wildfire.

The second set of papers examines community preparedness for wildfire, especially the factors that enable communities to meet the wildfire challenge over the long term. Communities examined by Kruger and others and Jakes and others varied by geographic location, population size, recent experience with wildfire, and ecosystem type. Kruger and her co-authors take lessons from observations of communities' actions to reduce fire risk. The authors show that availability of educational materials, emphasis on social networks and building relationships, coordination, and individuals taking responsibility for preparing homes are key factors. The paper by Jakes and co-authors tests a model for describing community social structure needed to successfully prepare for wildfires in three pilot communities in Minnesota, Oregon, and Florida. Their work showed that social, human, and cultural capital, agency involvement in level of preparedness, and recognition of the social aspects of landscapes are essential to community preparedness for wildfire.

The initial findings from these ongoing research projects clearly indicate the importance of understanding human attitudes, perceptions, and beliefs about fire in developing feasible fire management strategies. Development in the wildland-urban interface is expected to continue to expand, resulting in increasing numbers of individuals likely to experience wildland fire. The papers in this proceedings illustrate the complexity of the human dimension in fire management. Human attitudes and beliefs about fire may vary across numerous variables—e.g., attitudes toward fuel treatments may vary regionally. Homeowner attitudes toward prevention activities around their properties also vary markedly. These studies, in combination with other social science research, will help identify patterns of differences and similarities in human response to help managers design more effective strategies.

Effective strategies for collaboration among Federal, State, and local governments will also become increasingly important with continued expansion of the wildland-urban interface. Collaboration is needed not only in firefighting, but also in developing land management strategies that address fire risk across boundaries. Research that evaluates collaboration techniques and assesses community capacity for wildfire preparedness will provide useful input for determining how different levels of government can work together to improve wildfire preparedness.

A MODEL FOR IMPROVING COMMUNITY PREPAREDNESS FOR WILDFIRE

Pamela J. Jakes[1], Kristen Nelson[2], Erika Lang[2], Martha Monroe[3], Shruti Agrawal[3], Linda Kruger[4], and Victoria Sturtevant[5]

ABSTRACT.—Communities across the country are being told that they can take steps to improve their preparedness for wildfire. However, for these steps to have long-term impacts, the community must have the foundation necessary to continue these efforts after special programs have moved on or outside funding has been exhausted. Research is showing that sufficient levels of social capital, human capital, and cultural capital are important to wildfire preparedness. In addition, agency involvement and landscape can affect the success of wildfire preparedness efforts.

Anecdotal evidence and research leading to the development of programs such as Firewise, FireSafe, and FireFree suggest that there are steps that communities can take to reduce their risk from wildfire. Reducing wildfire risk is a focus in communities across the country. Even in areas not traditionally considered at high fire risk, storms, changing climate, and pest/disease outbreaks have focused attention on the potential for catastrophic fire. In addition, in areas where fire is viewed as a natural part of the ecosystem, the fact that more and more people choose these places to live in means that there is a greater potential for significant fire impacts.

We initiated a study of communities who are taking steps to increase their preparedness for wildfire. We are seeking answers to two questions:

1. What steps has the community taken to increase wildfire preparedness?
2. What social resources/conditions have been necessary to support these steps?

Our desired outcome is to increase wildfire preparedness by suggesting actions a community can take given its social and landscape characteristics.

Actions to increase wildfire preparedness are affected by decisions made by individuals and the community. Individuals have resources that influence and help implement decisions regarding the siting of structures, building materials, landscaping, access, and other factors that impact wildfire preparedness. Communities also have resources that influence and help implement their decisions relating to zoning, planning, education, and other activities that impact wildfire preparedness. Agencies within these communities have resources that influence and help implement their decisions relating to the purchase and availability of equipment and gear, scheduling and conduct of training, and implementation of protocols. Decisions made at both the individual and community levels come together in a set of actions aimed at increasing wildfire preparedness (fig. 1). As a result of these actions, we assume that communities will minimize their losses from wildfire and that recovery or restoration following a fire will be quick and effective. We could even argue that prepared communities will experience fewer fires. Many preparedness activities are aimed at reducing the fuel load in and around communities, lessening the chance that a lightning strike or other ignition source will find the fuel it needs to grow into a significant fire. In this study, we are interested in the actions taken by communities to

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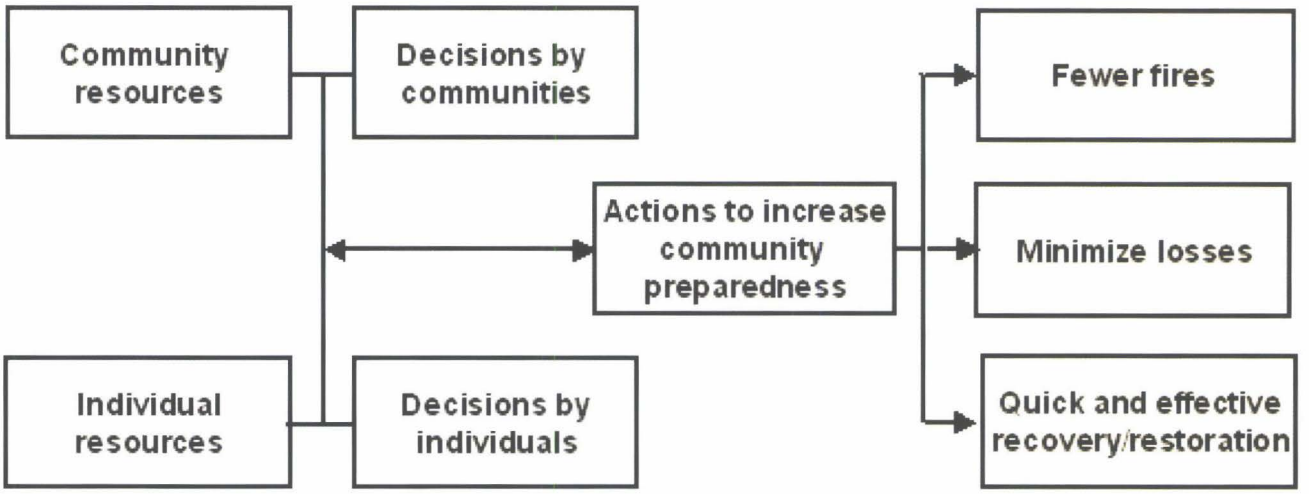

Figure 1.—*Model for understanding community preparedness for wildfire.*

increase wildfire preparedness and the social resources or conditions necessary to implement and support these actions.

We tested the model in three pilot communities: the Gunflint Trail community in northeastern Minnesota; Bend, Oregon; and Waldo, Florida[6] (fig. 2). Why these communities? We wanted to test the model in communities that represent different ecosystems, population sizes, and what we perceived as different levels of ongoing effort related to wildfire preparedness. We went to the Gunflint Trail because it is in a boreal ecosystem, with a history of fire, and had recently experienced a windstorm that resulted in a massive increase in the fuel load in the area. We were also interested in the Gunflint Trail because we had heard that individuals, the community, and different levels of government were involved in wildfire preparedness activities (fig. 3). We went to Bend, Oregon, because it is a fairly large community, in a high-desert, pine-chaparral ecosystem with a frequent and recent fire history. We were also interested in Bend as a representative of communities in high-amenity recreation areas that are experiencing significant population growth. We heard that there were a number of ongoing activities related to wildfire preparedness in Bend, primarily led by local government agencies and businesses with community buy-in. Finally, we went to Waldo, Florida, because it represents the flatwood pine ecosystem that is common to Florida. Fire is a frequent occurrence in this ecosystem. Unlike the other two pilot communities, Waldo is surrounded by industrial plantations rather than public land. We had heard that officials in Waldo had worked with the University of Florida's Conservation Law Clinic to search for an ordinance that would reduce their risk of fire. Waldo also is a bedroom community to Gainesville, Florida, and as such its wildfire preparedness challenges are different from Bend and the Gunflint Trail.

We used key informant interviews to collect information on what steps the community has taken to increase wildfire preparedness and what resources have been necessary to implement these steps. In each community we interviewed people whose jobs made them responsible, in part, for wildfire preparedness, including the Federal lands fire management officer, the State agency fire management officer, the county emergency preparedness official, the local fire chief, and the sheriff. In addition, we interviewed people whose job responsibilities are tied to wildfire preparedness in the community, including real estate agents, bankers, developers, and contractors. From each of these people, we obtained names of citizens who are active in wildfire preparedness. We also interviewed these involved citizens. Interviews lasted from 1 to 7 hours. We interviewed an average of 13 people in each pilot community (as of July 2002, a few interviews remained to be completed in each pilot community).

[6] More information on the lessons learned in each community, see companion article in this publication.

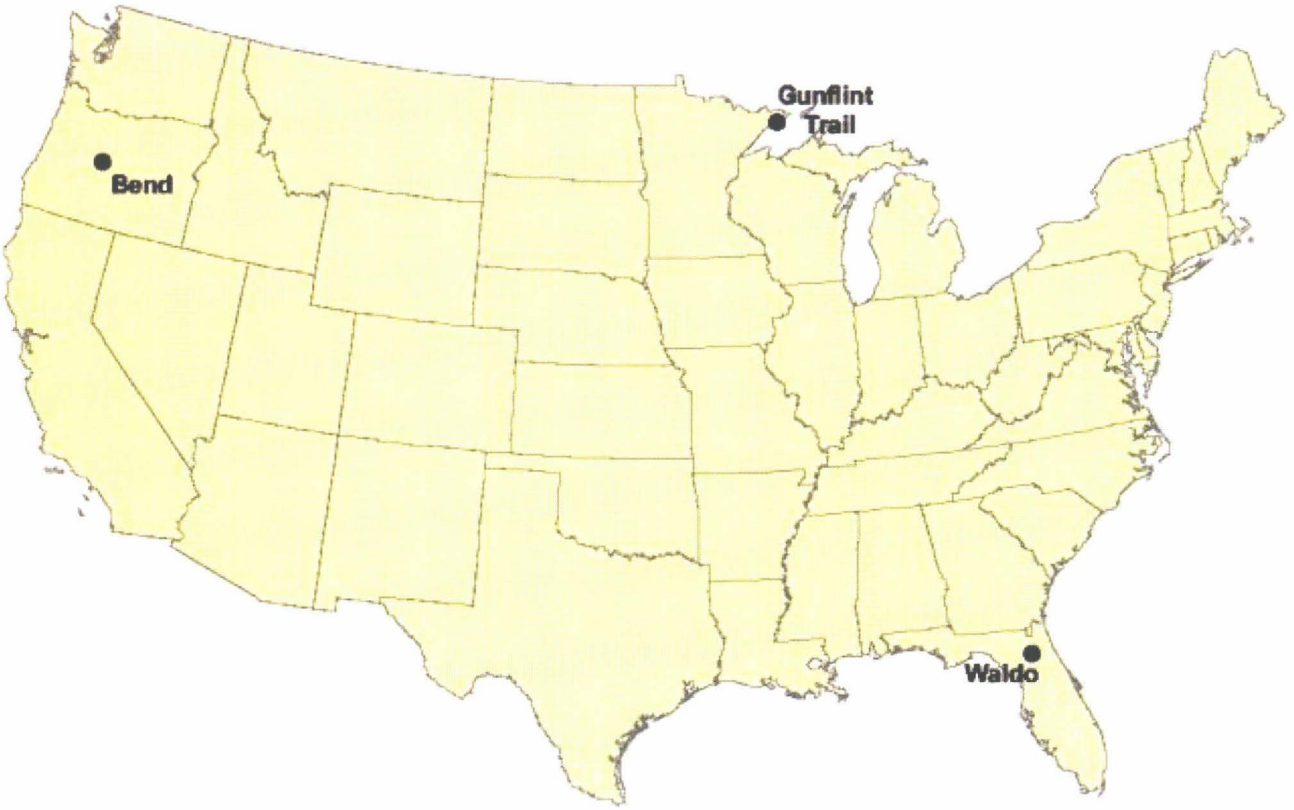

Figure 2.—*Pilot communities for studying community preparedness for wildfire.*

Figure 3.—*A member of the Gunflint Trail Volunteer Fire Department developed sprinkler systems to protect homes along the Gunflint Trail, Minnesota.*

From the case studies, we have begun to identify actions being taken by communities to increase wildfire preparedness. For example, a resourceful member of the Gunflint Trail Volunteer Fire Department used information provided from government sources to research, adapt, and install sprinkler protection systems for structures along the Gunflint Trail. A marketing firm in Bend created a community outreach campaign for creating defensible space and emergency preparedness. Annual spring campaigns encourage residents to clear their neighborhoods of woody debris and bring it to the county landfill, free of charge, for disposal (fig. 3). The Florida Division of Forestry recently hired wildfire mitigation specialists to coordinate public education with regard to wildfire preparedness in areas at risk of wildfire. Fire regional mitigation teams are deployed to reduce fuel loads on public and private property, and one has been active in Waldo, helping with prescribed fires and main-taining fuel breaks. Realizing the need for better and more timely communication of information, town managers throughout the County organized their own disaster communication system. When needed, a representative from a less affected town staffs the county fire rescue headquarters, passing along current information to other town managers.

Based on what we have learned from the pilot case studies, we began to define the social resources or community characteristics that are critical to wildfire preparedness. The first resource we identified is social capital. We are defining social capital as the community characteristics that contribute to collective social action. One component of social capital is leadership. Along the Gunflint Trail, we had strong leadership within the community to direct the wildfire preparedness efforts. As one Gunflint resident observed about their wildfire preparedness efforts, "Leadership is the critical piece." Another characteristic of social capital is networks. Groups like neighborhood block groups and lakeshore owner associations have been identified as critical to increasing wildfire preparedness. As observed by a project director in Bend, "I've had much more success working in areas where there are strong homeowner associations; it doesn't matter whether they are formed to fight city hall or what—they are a single point of contact, and easy to work with." A third indication of a community having social capital is the mobilization of resources, such as in Bend where local businesses and agencies bring their skills and resources to the FireFree campaign.

The second social resource important to community preparedness for wildfire is human capital. We define human capital as the knowledge and skills an individual obtains through education and training. On the Gunflint Trail, several people characterized the volunteer fire department as a white-collar fire department. Many members of the fire department are resort owners and outfitters who were described as "well-educated, smart, and level-headed." We were told that these well-educated people brought a certain approach or thought process to wildfire preparedness that resulted in well-reasoned and researched approaches to the problem. In Bend, the success of FireFree has been enhanced by the education and skills of local residents who can offer professional advice on the production of educational videos or development of pamphlets or other materials that are specific to local ecological conditions.

The third social resource important to community preparedness is cultural capital. Like human capital, cultural capital includes knowledge and skills of individuals, but it's knowledge and skills people possess because of their heritage, experience, and place attachment. One elderly resident of Waldo uses prescribed fire to maintain a healthy woodlot on his farm (fig. 4). From his father, he learned how to spread fire with a pine branch, when to burn, and how often to burn. Some members of the community credit his property with helping to deflect the recent wildfire away from the town. Along the Gunflint Trail and in Waldo, most of the people we talked to could discuss the fire history of the area, even residents with no direct tie to firefighting. On the Gunflint, one person talked about a "community memory" relating to the big fires that have occurred along the Trail. This person observed, "people associate the north woods with big fires." People described the Gunflint Trail residents as resilient because they had experienced big fires, had recovered, and therefore believed that they could do it again if they had to.

Figure 4.—*This landowner learned how and when to conduct prescribed burns from his father, and his approach to managing of his land is credited by some with turning a wildfire away from Waldo, Florida.*

We have identified agency involvement as the fourth social characteristic important to wildfire preparedness. Agency involvement could mean one agency working alone, a couple of agencies working separately but towards a common goal, or multiple agencies truly integrating their activities. Regardless of the approach, agency involvement was important in affording the local community access to the myriad of public programs providing funding and materials for wildfire preparedness. Agencies also provide expertise and skills to the community to aid in wildfire preparedness. For example, Deschutes County extension personnel are helping

develop lists of fire resistant plants that are used by Bend residents in landscaping. The county commis-sioner also used his lobbying skills to obtain permission for a Bend subdivision to create an alternative, emergency access that crosses a railroad track. Deschutes County plays an important role in reducing fuel loads by allowing Bend residents free access to the landfill several times a year so that they can dispose of debris from thinning and pruning—an important activity for improving community preparedness (fig. 5). In Waldo, a Florida Division of Forestry staff member works out of the Waldo Fire Station, improving communication and camaraderie between the agencies. The Alachua County Fire and Emergency Services unit has taken a leadership role in modifying the County Comprehensive Development Plan, making evaluation of wildfire hazard one element of the development approval process.

Figure 5.—*FireFree partner Deschutes County opens its landfill free of charge several times a year so that Bend residents can dispose of debris from the thinning and pruning necessary to create defensible space.*

Finally, the landscape becomes an important social factor related to wildfire preparedness. Most people would not classify landscape as a social factor—they think of landscape as the vegetation and topography that have a huge influence on fire frequency and risk. But there are also social aspects of the landscape. For example, along the Gunflint Trail, the residents are very aware that they are isolated from much of the rest of the State and are generally on their own when it comes to a number of services or activities. As observed by one resident, "One thing to remember is that there is no organized township, no government, no structure, no [formal] leadership. [Along the Trail there] have to be people who rise up and take it upon themselves." In addition, land ownership is a social characteristic of landscape that affects wildfire preparedness. Along the Gunflint, people described their community as "a peninsula surrounded by a sea of public ownership." Resource and fire management approaches on this public land will have a major impact on wildfire preparedness along the Gunflint Trail. In Waldo, because the major forest landowners in and around the community are the private timber companies, they have become partners in wildfire preparedness by maintaining fuel breaks. They have also increased communication between their staffs and the Florida Division of Forestry fire crews. Major Florida fires now involve firefighters on incident command teams and equipment from the State forestry agency, county fire departments, and private industry.

We expanded our wildfire preparedness model to include the necessary social foundation discussed above: social capital, human capital, cultural capital, agency involvement, and landscape (fig. 6). We are currently testing this model in six additional communities: the Drummond-Barnes area of northwestern Wisconsin; Spearfish, South Dakota; Roslyn, Washington; Applegate, Oregon; Balstrop, Texas; and Palm Coast, Florida. We will test the model in at least 15 communities nationwide.

Figure 6.—*Preparing a community for wildfire includes a variety of activities and must be supported by a strong social foundation.*

The product of this research will be recommendations for actions a community can take to increase wildfire preparedness based on the ecological characteristics of their landscape and the social characteristics of the community. The outcome of this research will be communities who, if they experience a wildfire, will minimize their losses and recover more quickly because they have implemented these recommendations and are prepared for wildfire.

ACKNOWLEDGMENTS

This research was conducted under research joint venture agreements with the authors' universities and funded by the National Fire Plan through the USDA Forest Service, North Central Research Station, St. Paul, Minnesota.

KEYS TO COMMUNITY PREPAREDNESS FOR WILDFIRE

Linda E. Kruger[1], Shruti Agrawal[2], Martha Monroe[2], Erika Lang[3], Kristen Nelson[3], Pamela Jakes[4], Victoria Sturtevant[5], Sarah McCaffrey[6], and Yvonne Everett[7]

ABSTRACT.—Assessments of a community's vulnerability to wildfires often focus on landscape conditions or ecological factors such as forest type, age distribution, forest health, topography, or hydrology. However, vulnerability is also a function of a variety of social factors. We need to understand both the social and ecological factors that influence community vulnerability to wildfire so that we can recommend strategies to decrease a community's risk within a given landscape. By learning how communities are preparing for wildfire and taking action to reduce risk, we can share examples of community preparedness activities with other communities and better understand how to support communities in taking action.

Assessments of a community's vulnerability to wildfires often focus on landscape conditions or ecological factors such as forest type, age distribution, forest health, topography, or hydrology. However, vulnerability is also a function of social factors, such as a community's attitude, beliefs, and perceptions about fire; networks, leadership, and capacity to mobilize resources (social capital); knowledge and skills (human capital); heritage and experience with fire, knowledge of the area, and attachment to place (cultural capital); a community's ability to bounce back or recover from disasters such as wildfire (community resiliency); and agency involvement. Other more specific examples of social factors include regulations at the neighborhood, city, county, State, and Federal level that mandate land use, vegetation manage-ment, or residential requirements and restrictions. In addition, various social factors have an impact on a community's ability to coordinate disaster preparedness with neighboring communities and with county, State, and Federal agencies. Organizational culture, institutional style, and the strength and nature of horizontal and vertical ties within and between communities and agencies can all have an impact on successful fire management planning and implementation. We need to understand the social and ecological factors that influence community vulnerability to wildfire so that we can recommend strategies to decrease a community's vulnerability within a given landscape.

Case studies of community preparedness for wildfire were discussed at the 2002 International Symposium on Society and Resource Management (ISSRM).[8] These case studies describe what some communities are doing to reduce their wildfire risk. By discussing each of the communities, below, we can uncover clues to social factors that are important in helping a community prepare for wildfire.

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[8] Three of the case studies are part of a larger study discussed elsewhere in this volume (Jakes *et al.*).

WALDO, ALACHUA COUNTY, FLORIDA

Introduction to Waldo

Waldo is a small rural community in north-central Florida. It once thrived as a farming town and tourist destination, but when freezes ruined the citrus groves and transportation networks moved (with the railroad shifting operations to a larger city, and the interstate being located further west), the town's population began to shrink. The population of Waldo in 2000 was 840 residents, a 20 percent decline in the last 10 years. Waldo now serves as a bedroom community to Gainesville, the seat of Alachua County and home of the University of Florida.

People who remain in Waldo share a strong sense of community. The incorporated town of Waldo is 2.4 square miles and includes a few businesses, antique shops, churches, an elementary school (through grade 5), and residences. Pine plantations, rangeland, pecan groves, and forests surround the community. The Waldo Fire Department has six paid staff members.

Waldo is at risk from wildfire due to the broad expanse of private forest land that surrounds it. The land is not within Waldo's jurisdiction, and options for influencing management are few. In 1998, fire entered the town of Waldo after firefighters battled the blaze for 3 days and residents had to be evacuated. Two factors contributed to the fire—heavy fuel loads and hot, dry, windy weather. In May 2000, a series of fires broke out in the same area near Waldo. The 1998 Florida fires prompted major new initiatives in the Florida Division of Forestry (DOF), Alachua County, and Waldo itself. Today, people in Waldo are more aware of wildfire, but there is still no cohesive community activity to increase preparedness. Community residents are content to leave the responsibilities for preparing for and fighting wildfire in the hands of county and State agencies.

Keys to Wildfire Preparedness in Waldo

Experience—Community leaders agree that the experience of the 1998 wildfires gave them a chance to improve equipment, training, and communication. The fire was a learning experience for many, and the severity of the fire made many leaders aware of how vulnerable Waldo is, how difficult it is to control wildfire, and what strategies seem to be helpful—foam, water, and vegetation management.

Networks and relationships—People in small towns know each other. These relationships are significant resources in a crisis. During the 1998 fires, the large Fellowship Hall of the First Baptist Church was used as a feeding center for personnel, and the area around the church was used as a staging area for equipment and crews. Waldo church members organized themselves to serve three hot meals to firefighters daily. This experience of helpfulness and success inspired them to believe that they can organize themselves in emergencies. When fire threatened the town in 2000, it did not take long to organize the kitchen crew.

Agency commitment and communication—Waldo's small jurisdiction and small budget mean that it must depend on other agencies to contain a wildfire (fig. 1). Staff at both the Alachua County Fire Rescue and DOF are working with landowners in and near Waldo to implement fire prevention and mitigation strategies. To improve communications, small town managers in the county organized their own disaster communication system. The Florida Fire Chiefs Association and the Florida State Fire Marshals have established caches of communication equipment around the State. A DOF liaison officer in each district also communicates with local fire departments to

Figure 1.—*The small jurisdiction and budget for Waldo, Florida, mean that it must depend on other agencies and groups to help prevent wildfire, as is the case with this utility right-of-way that is maintained as a firebreak. (Photo: S. Agrawal 2001)*

inform everyone of weather predictions, equipment locations, and available resources.

Resources and equipment—After the 1998 fires, the Waldo Fire Department bought two surplus military trucks and converted them into brush trucks with water tanks. All Waldo Fire Department firefighters have wildland firefighting training and gear. In addition, the county and the State have a plethora of resources including two gyro tracks, mowers, brush trucks, and helicopters that are available to fight wildland fires.

Agreements and contracts—Waldo has a statewide mutual aid agreement in place that commits it to provide and receive assets including people and equipment in case of an emergency.

Other county and State initiatives—Several agencies conduct wildfire education programs that complement the national FireWise program. Regional Prescribed Fire Councils have been active with the State legislature and continue to sponsor awareness weeks and quarterly meetings. Alachua County has included consideration of wildfire hazard along with other elements in the comprehensive development plan. Public education, mitigation, and ongoing maintenance of newly developed regions, and a fuel reduction program are part of the plan. As a result of a statewide effort to reduce hazardous fuel loads near communities, DOF established wildfire mitigation teams in several districts, along with wildfire mitigation specialists to coordinate media and education programs. Prescribed fire, fuel breaks, thinning, and mowing activities are conducted with landowner approval around subdivisions and communities.

Training—DOF conducts training for Prescribed Burner Certification as well as a host of Incident Command courses. There are four complete incident command teams in Florida consisting of officials from DOF and local fire departments.

THE GUNFLINT TRAIL, COOK COUNTY, MINNESOTA

Introduction to the Gunflint Trail

The Gunflint Trail, located in the northeastern tip of Minnesota, runs for 62 miles northwest from the town of Grand Marais and provides access to homes, resorts, summer cabins, and campgrounds in northern Minnesota's boreal forest. Nearly 2,500 people live along the Gunflint, and more than 1,800 of these are seasonal residents. Ninety percent of the land is in public ownership, managed by the USDA Forest Service and the Minnesota Department of Natural Resources. The trail ends at Seagull Lake and the Boundary Waters Canoe Area Wilderness, which is the most popular wilderness area in the United States. Fire has always been part of this landscape. Every year, the Gunflint Trail Volunteer Fire Department, USDA Forest Service, Minnesota Department of Natural Resources, and other partners fight numerous fires along the Trail. In addition, a major storm in 1999 blew down more trees on more than 600 square miles of forested land, further increasing fuel loads and returning fire to the forefront as a resource management issue.

Keys to Wildfire Preparedness on the Gunflint Trail

Know your place—Residents along the Trail know the fire history of the area and understand the role of fire in the ecosystem (fig. 2). They have thought about the implications of the blowdown and how their isolation impacts their ability to protect homes and businesses from

Figure 2.—*The 1995 Saganaga Lake fire showed the residents along the Gunflint Trail in Minnesota that they could respond to a wildfire, and lessons learned from that fire helped the community find ways to improve their response. (Photo: Gunflint Trail Volunteer Fire Department Web site: www.gunflint911.org)*

wildfire. Educational materials related to risks associated with wildfire along the Trail build on this local knowledge and reflect local conditions.

Build a wildfire preparedness program using existing partnerships and networks—There was no need to develop new networks or partnerships in order to increase community preparedness for fire. Because of existing relationships, it was easy to bring people together to work toward reducing the risk of wildfire. Agency representatives worked with community business leaders and residents to demonstrate a united approach. Mutual aid agreements exist, and equipment and personnel are shared.

Build on local knowledge and skills—Residents along the Trail have, or have access to, knowledge and skills that increase their preparedness for wildfire. Several examples of a "can-do" attitude were identified. For example, the volunteer fire department organizes fundraisers throughout the community to purchase new equipment and is looking for ways to offer retirement benefits to firefighters to decrease volunteer turnover. A resident has investigated wildfire sprinklers and encourages other residents to purchase them for their homes and businesses.

Keep an open door and mind—People along the Trail do not always agree on environmental issues. Therefore, improving wildfire preparedness has meant setting aside disagreements to work for the common good. Government agencies have maintained an open door policy, working with residents and businesses to find ways to accomplish what needs to be done. Residents are taking responsibility for increasing preparedness of their homes and neighborhoods.

Wildfire preparedness is a process, not a product—Activities to improve wildfire preparedness are part of a larger process of taking responsibility for choosing to live and work in an isolated area in a fire-prone ecosystem. The process does not end with creating defensible space, improving access, or installing sprinkler systems but includes a variety of ongoing networking activities that build, enhance, or create partnerships along the Trail.

BEND, DESCHUTES COUNTY, OREGON

Introduction to Bend

Bend, located in central Oregon's high desert, is a community rich in environmental amenities and outdoor recreation opportunities. The annual precipitation is around 12 inches and the ecosystems are fire dependent. Both the city of Bend, at 52,000 population, and Deschutes County, at 115,000, are among the fastest growing areas in the State (fig. 3). One of the challenges faced by planners and elected officials is the expansion of homes and residential subdivisions into forested areas, jeopardizing the ability of fire crews to balance risks to forests and homes.

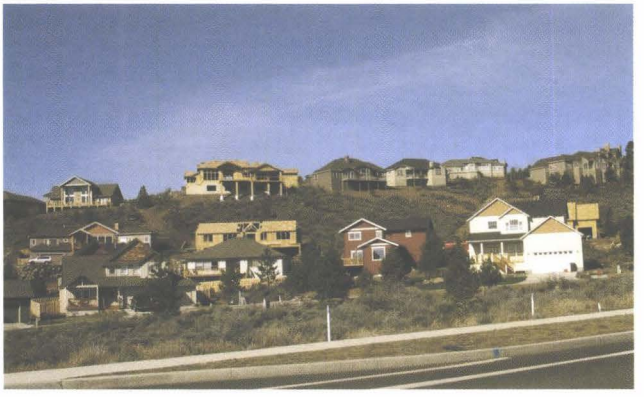

Figure 3.—*Both Bend and Deschutes County are among the fastest growing areas in Oregon, increasing the challenge for those responsible for wildfire preparedness. (Photo: V. Sturtevant 2002)*

Two fires—the 1990 Awbrey Fire, which burned 3,000 acres and 22 homes, and the 1996 Skeleton Fire, which burned 17,000 acres and 30 homes—brought home the reality of wildfire to the city of Bend. SAFECO, an insurance company covering enormous losses incurred in these fires, offered seed money to reduce fire risk in the area. Bend's fire marshal suggested a public education campaign. A marketing company was hired, and the wildfire preparedness program FireFree was born.

Federal agencies manage 85 percent of the land in Deschutes County, and their personnel have developed an exhaustive knowledge of the region's fire ecology. Early participants in FireFree, they recognize the importance of coordinating efforts to reduce risk of wildfire on private and public lands. They also see FireFree as an opportunity to work productively with the public as stewards of natural resources.

Keys to Wildfire Preparedness in Bend

Individual responsibility—At the core of FireFree is the belief that individuals can make a difference—that homeowners can take steps to reduce their risks from wildfire. Most of the "ten tips" for "getting in the zone" and reducing wildfire risk relate to creating defensible space, reducing vegetation, and clearing brush around homes. FireFree delivers its message via the media, a public speakers bureau, and educational materials provided by businesses in public areas or distributed door to door. It is also a message that is keyed to conditions in Bend.

Peer pressure and community spirit—Cleanup campaigns are organized to get everyone involved. FireFree conducts an annual spring campaign that leads to three cleanup weekends when the county landfill invites residents to bring in their yard debris, free of cost. Local fire and land management agencies provide volunteers and equipment. Grants help neighborhoods rent chippers, hang banners, and provide refreshments—whatever it takes to get everyone involved.

Networks—A diverse community with a number of highly skilled individuals and strong leadership, Bend has several connected and active civic organizations. Neighborhoods and subdivisions range from mobile homes and small houses to gated communities with homes around private golf courses. FireFree recognizes this diversity and uses the city's existing organizational networks to bring an array of messages to the different homeowners.

Collaboration—Local businesses, non-profits, and county and Federal agencies collaborate to make FireFree a success. Project Impact, a program funded by FEMA (Federal Emergency Management Agency) for overall disaster preparedness has partnered with the High Desert Museum for a lecture series on fire ecology and on-site fuels modification projects. The demonstration project will reduce the threat of wildfire to the museum and bring the message of wildfire prevention to local visitors and thousands of tourists visiting the museum. A local developer has demonstrated defensible space, and local nurseries market fire-resistant landscaping.

Sense of place—Many of Bend's residents were drawn to the area because of its natural beauty. The community has a strong environmental ethic, and neighbors know they have to learn how to co-exist with wildfire. Reaching newcomers unaware of the historical significance of fire and absentee landowners with fewer community ties will continue to be a challenge.

INCLINE VILLAGE, WASHOE COUNTY, NEVADA

Introduction to Incline Village

Incline Village, Nevada, is an unincorporated mountain resort community located on the northeast shore of Lake Tahoe. Nearly half of the town's population are year-round residents, with a little over 9,000 permanent residents and a summer population nearing 18,000. The town is an intermix community with houses interspersed in the forest, and the only real open space is found at the town's golf courses.

The main focus of all environmental activity in the basin is on maintaining Lake Tahoe's stunning water clarity and quality. To this end, all development activities are managed by the Tahoe Regional Planning Agency—a bistate regional planning group. New development is limited, and logging in the basin is done under very restricted conditions. There have been few significant wildfires in the basin in the past 80 years; however, extensive clear-cutting in the late 1800s followed by fire suppression has left the basin with very significant fire danger.

The North Lake Tahoe Fire Protection District administers fire responsibilities, including fire education. In the late 1980s, the fire district initiated a proactive fire management program to decrease the wildfire risk. The program included extensive education work as well as a detailed fire management plan that included initiating prescribed burns within the town (fig. 4). The fire education campaign used a diverse array of tools, including brochures, neighborhood meetings, newspaper articles, and

computer simulations. Tools were targeted to different audiences such as realtors, local businesses, and school children to educate residents about the fire hazard and defensible space and to engage them in proposed fuel management projects.

Keys to Wildfire Preparedness in Incline Village

Target messages to show how fire will affect a specific group—Realtors balked at the idea of handing out fire hazard information to prospective buyers or rental units. However, with education they began to appreciate the potential of trying to sell or rent property in a blackened landscape and they were more cooperative.

Be creative—A variety of techniques were used to reach as many people as possible using traditional approaches such as newspaper articles, television stories, and portable displays, and innovative efforts including an Incline Village Wildfire Report Card and use of a fire behavior computer program to create a hypothetical wildfire scenario in Incline Village.

Figure 4.—*As part of its proactive fire management program, the North Lake Tahoe Fire District is using prescribed burns to reduce fuels. (Photo: North Lake Tahoe Fire District Web site: www.nltfpd.net)*

Get personal—The Fire Marshal and firefighters actively talked with town residents about the problem. Residents who cited a government or personal contact as an information source were more likely to have more progressive views on wildfire management.

Reach out to part-time residents—Efforts were successful in that seasonal single family homeowners were as likely as permanent single family homeowners to be aware of the fire program and those who were aware of the program were more likely to have an evacuation plan and to see the fire hazard as severe.

TRINITY COUNTY, CALIFORNIA

Introduction to Trinity County

Trinity County in northern California encompasses 3,300 mountainous square miles, over 75 percent of which is public land managed by the USDA Forest Service and the Bureau of Land Management. Fewer than 14,000 people live in a handful of unincorporated communities, of which Weaverville, population 3,554, is the largest. The county has a long history of mining and timber production. Logging was brought nearly to a standstill with the reduction in harvesting from national forests in the early 1990s. Communities are struggling to survive the resulting economic downturn by diversifying with a stronger focus on recreation around Trinity Lake, on the Trinity River and in the Trinity Alps Wilderness, and on value-added commodity production from the local forests.

Fire is the dominant disturbance regime in the mixed conifer forests and oak woodlands surrounding the communities. Major fires burned thousands of acres in the county in 1987 and 1999, and three fires of over 1,000 acres each burned homes and threatened the communities of Lewiston, Weaverville, and Hayfork in 2000 and 2001. People in the county know it is not a question of whether their area will burn but when. Sixteen volunteer fire departments cooperate with the California Department of Forestry and Fire Protection and the USDA Forest Service on fire suppression in communities and surrounding wildlands.

Keys to Wildfire Preparedness in Trinity County

Agreements and contracts—The California Department of Forestry and Fire Protection has four- and five-party agreements with the major Federal land management agencies on cooperation for fire suppression activities statewide. The volunteer fire departments are responsible for structure fires but in reality are also first responders for vegetation and wildland fires in and around communities as well.

Agency commitment and communication—California has a multi-stakeholder State-level fire safe council, which endorses community based fire safe councils and supports them with information and cooperation from the California Department of Forestry and Fire Protection.

Networks and partnerships—Trinity County citizens have a history of self-reliance and community engagement and have been actively involved in natural resource management decisions on the surrounding national forests since the Northwest Forest Plan began to be implemented in the mid-1990s. In 1998, two local not-for-profit organizations—the Trinity County Resource Conservation District and the Watershed Research and Training Center—joined forces with local representatives of State and Federal agencies and citizens at large to form the Trinity County Fire Safe Council. They developed a memorandum of understanding endorsed by the County Board of Supervisors and signed by 13 stakeholder agencies and groups to collaborate on strategic planning to address the risk of catastrophic fire.

Proactive use of local knowledge and skills—The Trinity County Fire Safe Council meets monthly and is making headway on developing a county fire management plan. A strong element of the plan is pre-fire fuels treatment. Fuel reduction efforts in critical locations on public and private land are seen as valuable for protection of key assets from fire, as well as a potential opportunity for forest-related employment and as a source of wood products. The Watershed Research and Training Center has pioneered low-cost, low-impact small diameter thinning and value-added wood processing for economic diversification in the region.

As part of the strategic planning process, meetings have been held at fire halls throughout the county at which community members and Fire Safe Council representatives have mapped data pertinent to emergency response and have identified and prioritized values at risk in the landscape (fig. 5). The resulting Geographic Information System (GIS) has been made available to emergency response agencies and volunteer fire departments on CD-ROM. Project proposals to State and Federal agencies for fuels reduction work based on community-defined priorities have been developed, funded, and implemented.

Figure 5.—*Community mapping of data necessary to providing emergency services is an integral part of the Trinity County Fire Safe Council's strategic planning process. (Photo: C. Fall 2001)*

Defining common ground—While there are heated debates in the area about the best fire management policies for Federal lands, agreement about cooperation on fire suppression and fuels reduction in and around communities is strong. Long-time residents tend to believe that they can reduce risks from fire to their homes, and many work on their own or increasingly with the Fire Safe Council in neighborhood fuel reduction efforts. The Trinity County Resource Conservation District has led in organizing neighborhood workdays, bringing in volunteer crews and providing chippers for slash. With the

assistance of registered professional foresters, work crews have constructed a number of shaded fuel breaks designed to help firefighters protect housing developments. As in other communities, absentee landowners are more difficult to involve and will continue to be a challenge. Overall, the visibility of the Fire Safe Council is increasing, and it is beginning to bring resources for fire management into the county.

DISCUSSION

The communities described here represent very different situations, from Incline Village where there is high social capital but little direct experience with wildfire to Waldo where there is little social capital but recent experience with wildfire. Yet, some factors related to community preparedness for wildfire are common to several of our communities. First is the importance of developing educational materials that reflect both the intended audience and the history and current conditions of the community. Wildfire education is not a situation where one size fits all. If education programs are to be effective, they must be relevant to local residents. Local knowledge and skills can be employed in the development of site-specific educational materials, involving citizens and in many cases reducing the costs of development. Second is the importance of networks and building on connections and relationships established in these networks. Particularly important is a mutual working relationship between agencies and landowners. No one part has the whole answer, and effective wildfire preparedness requires active and open communication. There also is no reason to invent a new system for distributing wildfire preparedness information when groups such as landowner associations, Scouts, and the PTA are already in place, with networks and connections that can serve a number of purposes. Third is the importance of coordination. It is confusing for residents to have local, State, and Federal representatives contacting them about wildfire preparedness, when a coordinated team of people representing the different interested agencies or groups can demonstrate the importance of teamwork and cooperation while more efficiently taking steps to increase wildfire preparedness. Finally, the programs developed in these communities recognize the importance of individuals taking responsibility for preparing their homes for wildfire. The idea that individuals can make a difference is a powerful one—one that can determine the success or failure of any wildfire preparedness initiative.

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SCALE DEVELOPMENT OF WILDFIRE MANAGEMENT BASIC BELIEFS

Alan D. Bright[1], Jerry J. Vaske[1], Katie Kneeshaw[1], and James D. Absher[2]

ABSTRACT.—Understanding how the public feels about fire management issues has become a priority for many natural resource agencies. Based on work on wildlife basic beliefs, we developed scales for measuring basic beliefs about wildfire management. Identification of basic beliefs about wildfire management helps agencies predict public attitudes toward fire policies, norms for agency reactions to wildfire, and fire-related behavior (e.g., creating defensible space). Results supported the existence of wildfire management basic belief dimensions, opening the way for additional research in their development.

Recent wildfires in the Western United States highlight the need for understanding the human dimension of forest and wildfire management. Large–scale fires impact natural ecosystems as well as private and public property. Wildfires may also impact recreation and tourism and the perceptions of people engaging in these activities. The short- and long-term biophysical effects of wildfires influence fire management operations and area closures, and disrupt human life.

Perceptions of fire management are ultimately rooted in the fundamental values that individuals hold. It therefore follows that forest managers need to understand how values relate to perceptions about fire management issues such as prescribed fire, fuel treatments, fire suppression, and post–fire forest health issues. Fundamental values are defined as enduring beliefs that are used to evaluate the desirability of specific modes of conduct or the ends achieved through such conduct (Rokeach 1973). In any given society, people hold relatively few fundamental values (dozens), which are slow to change. Although fundamental values are connected to thoughts and actions, they are too broad to address differences in what people think regarding specific wildfire management.

The cognitive hierarchy provides a theoretical framework for connecting the basic fundamental values that the public holds with more specific beliefs about forest and wildfire management. This hierarchy suggests that an individual's fundamental values are oriented to specific wildfire management issues by basic beliefs about wildfire management. These basic beliefs, representing value–laden perceptions of wildfire management, directly influence attitudes and norms regarding specific wildfire management issues. In turn, attitudes and norms have a direct impact on behaviors related to wildfire management such as the development of "defensible space" around one's residence or support for agency fire management actions such as prescribed burns and mechanical thinning.

Basic beliefs emerge from and give meaning to fundamental values. They serve as a connection between values and attitudes, norms, and behavior related to specific issues, such as wildfire management. While two people might emphasize the importance of the same fundamental value, they could differ from one another on their basic beliefs concerning the application of that value. For example, two people may hold the same fundamental value that emphasizes the importance of the natural world. For one person, this value may lead to the basic belief that all nature should be protected, causing that person to oppose allowing wildfires to burn due to the potential harm to wildlife habitat. For the second person, this same fundamental value may lead to the basic belief that wildfire is a part of nature and should be allowed to burn, maintaining its natural place in the evolution of nature.

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Purpose

Much of the previous research on basic beliefs in natural resources has occurred within the field of wildlife management (Bright *et al.* 2000, Fulton *et al.* 1996). These authors identified dimensions such as wildlife rights, welfare, and appreciation. Vaske and associates (Vaske and Donnelly 2000, Vaske *et al.* 2001) extended the concept of basic beliefs and their orientation of values to forest management by identifying and measuring a biocentric/anthropocentric orientation. The purpose of this paper is to describe the initial process of developing items designed to measure basic belief dimensions related to wildfires and their management. These value–laden cognitions are designed to be closely related to fundamental values and may 1) show more variance across a society than do fundamental values, 2) relate more directly to fire management than do fundamental values, and 3) predict attitudes, norms, and behavior related to specific wildfire management issues in future research. The objectives were to

1. Develop survey items that were reflective of basic beliefs about fire management,
2. Link patterns of basic beliefs to fundamental values, and
3. Compare the structure of the identified basic belief dimensions across groups of visitors to three national forests: Arapaho–Roosevelt National Forest near Denver, Colorado; Mt. Baker–Snoqualmie National Forest near Seattle, Washington; and San Bernardino National Forest near Los Angeles, California.

Six wildfire management basic belief dimensions were identified based on a review of popular and scientific literature on public perceptions of wildfire management. While not exhaustive, they represent key value–based dimensions proposed to drive public perceptions of wildfire management issues. The first two dimensions draw from the work of Vaske and associates by replicating the use of anthropocentric and biocentric basic belief dimensions

1. **Anthropocentric** – This dimension reflects the extent to which the role of humans is of primary concern regarding natural resource and environmental management.
2. **Biocentric** – This dimension reflects the extent to which the health and welfare of ecosystems and their components (e.g., habitat and wildlife) are of primary concern in natural resource and environmental management.

The next three dimensions can be directly traced to the work of Rokeach (1973) in describing terminal and instrumental fundamental values

3. **Responsibility** – Rokeach (1973) describes this fundamental value as reflecting dependability and reliability. A responsibility basic belief dimension related to wildfire management addresses who is responsible for protecting homes built in or near the urban–wildland interface and who is responsible for managing the risk of wildfire (e.g., private landowners, public agencies, both).
4. **Capable/Trust** – This fundamental value is related to Rokeach's concept of competence and effectiveness. As applied to wildfire management, a capable/trust basic belief dimension reflects the extent to which the public "trusts" the ability of public agencies to effectively manage wildfire.
5. **Freedom** – Rokeach describes this fundamental value as independence and free choice. As related to wildfire management, a freedom basic belief dimension refers to the extent that private landowners should be free to or constrained from building private residences in or near the urban–wildland interface where wildfire may occur.

Our sixth basic belief dimension addresses the extent to which the public perceives a place for wildfire in natural processes

6. **Benefit/Harm** – This identifies a general belief about whether wildfire is beneficial or harmful to nature.

METHODS

This study examines the reliability and validity of the six fire management basic belief dimensions. A pre-test of 200 Colorado State University students provided a preliminary assessment of the survey items and associated scales (i.e., basic belief dimensions). The items and scales were then evaluated using a broader sample of national forest visitors.

Sampling

The target population was visitors to three national forests: Arapaho–Roosevelt National Forest in north central Colorado near Denver, Mt. Baker–Snoqualmie National Forest in western Washington near Seattle, and the San Bernardino National Forest in southern California near Los Angeles. These three forests were chosen specifically for their close proximity to a metropolitan region. Visitors to each of the respective forests were approached and, after responding to a one-page on-site survey, were asked if they would be willing to complete a mailed questionnaire about perceptions of wildfire and its management. Altogether, 3,131 individuals were approached across the three forests. A total of 2,762 provided names and addresses of which 2,530 were usable and/or deliverable.

Data Collection

A modified "tailored design" approach (Dillman 2000) for mail surveys was used to collect data. Approximately 2 weeks following the initial questionnaire mailing, a reminder postcard was sent. Two weeks later, a second mailing of the questionnaire was conducted. Of the 2,530 subjects, 1,288 mail surveys were returned for an overall response rate of 51 percent. Response rates for the individual forests were Arapaho–Roosevelt, 56 percent (469 of 837 returns); Mt. Baker–Snoqualmie, 54 percent (498 of 917 returned); and San Bernardino, 41 percent (321 of 776 returned). As a check on potential nonresponse bias, on–site respondents who completed the mail survey were compared against the on–site respondents who did not return the mail survey (i.e., the grouping variable). For all the variables on the on-site survey (the dependent variables), the Hedge's g effect sizes were $\leq .2$, indicating only a "minimal" relationship (Vaske *et al.* 2002). Nonresponse bias was thus not considered to be a problem and the data were not weighted.

Factor Measurement

Each item in the anthropocentric, biocentric, responsibility, freedom, and capable/trust basic belief dimensions were measured using a seven-point scale ranging from "strongly disagree" (1) through a "neutral" point (4) to "strongly agree" (7). To measure the benefit/harm of wildfire dimension, respondents rated whether wildfires in national forests, parks, and other natural areas are bad/good, harmful/beneficial, and negative/positive on seven–point semantic differential scales ranging from "extremely bad, harmful, and negative" (1) to "extremely good, beneficial, and positive" (7).

Analyses

Reliability (Cronbach's alphas) analysis was initially used to examine the internal consistency of the items associated with each of the six basic belief dimensions. A confirmatory factor analysis tested whether the specific survey items and basic belief dimensions provided a good fit to the data. The basic belief factor structures were then compared across the three national forests using structural equation modeling.

RESULTS

Scale Validation – Pre-Test

Table 1 presents the results of reliability and confirmatory factor analyses on the items used for each basic belief dimension in the pre–test. The goodness of fit indices suggested that the data were a good fit of the model ($X^2/df = 2.16$; NFI = .955; CFI = .975; GFI = .973). These items were then used to measure the six belief dimensions on the broader national forest visitor survey.

National Forest Visitor Survey

The first step of the analysis of the national forest visitor survey was to ensure that the scales used to create the wildfire management basic belief dimensions were appropriate for the creation of indices. Cronbach's alpha was used to determine the internal consistency of the scales. All of the basic belief dimensions showed high internal consistency (biocentric scale, $\alpha = .86$; anthropocentric scale, $\alpha = .77$; responsibility scale, $\alpha = .70$; freedom scale, $\alpha = .75$; capable/trust scale, $\alpha = .79$; benefit/harm scale, $\alpha = .91$).

Table 1.—*Results of confirmatory factor analysis of basic belief items and reliability analysis of the pre-test data*

Basic belief dimension/item	Factor loading	Cronbach's α
Biocentric		.791
• Nature has as much right to exist as people.	.936	
• Forests have as much right to exist as people.	.873	
• Forests have value whether people are present or not.	.472	
• Wildlife, plants, and people have equal rights.	.607	
Anthropocentric		.801
• The value of forests exists only in the human mind.	.649	
• Nature's primary value is to provide products useful to people.	.754	
• The primary value of forests today is to provide places to play and recreate.	.652	
• The primary value of forests is to provide timber, grazing land, and minerals for people.	.632	
• Forests are valuable only if they produce jobs and income for people.	.705	
Responsibility		.773
• Homeowners are the most responsible for protecting their homes, near a forest, from wildfire.	.536	
• When people build homes near forests, it is their own fault if their home is damaged by wildfire.	.601	
• When people build homes near forests, they have the right to expect their home will be protected from wildfire by the government agency managing the forest.	.721	
• The community fire department is the most responsible for protecting homes built near a forest from wildfire.	.551	
• The government agency that manages the forest is the most responsible for protecting homes built near a forest from wildfire.	.655	
• If a wildfire breaks out in a forest, the first priority of the agency managing that forest is to make sure private property is not destroyed.	.529	
Freedom		.735
• People should be allowed to build homes where they want, even if it is in a high wildfire zone.	.521	
• People should not be allowed to build homes near forests where their homes could be destroyed by wildfire.	.823	
• Laws should prohibit building homes where they can be burned by wildfires.	.785	
Capable/Trust		.745
• Setting prescribed fires in order to decrease the threat of future wildfire is an appropriate strategy for managing forests.	.837	
• Prescribed fire is too uncontrollable to be an appropriate forest management tool.	.660	
• Forest managers should not use artificial methods to manage a natural process like forest fires.	.649	
Benefit/Harm		.909
Wildfires in National Forests, Parks, and other natural areas are:		
• Bad/Good	.852	
• Harmful/Beneficial	.908	
• Negative/Positive	.876	

Goodness of fit indices from structural equation analysis using Amos 4.0 found the data to be a good fit of the model ($X^2/df = 2.16$; NFI = .955; CFI = .975; GFI = .973).

The second analysis step examined the extent to which the factor structures validated in the pre–test were equal across the study strata (table 2). Two structural equation models were compared. The first model assumed that the factor structure of wildfire management basic belief dimensions was the same across the three study strata. This model was compared to a model that allowed the factor structures of basic beliefs to vary across the three strata. The analysis revealed acceptable fits for both the "equal" (X^2/df = 2.69, NFI = .90, CFI = .90) and "varied" (X^2/df = 2.71, NFI = .90, CFI = .91) models. In general, this analysis implied that the basic belief dimensions might be generalized across the national forests examined. A comparison of the two models using the change in chi–square statistic, however, indicated that the model allowing the basic belief factor structures to vary across the three strata was statistically superior ($\Delta X^2 = 83.29$, $p < .05$).

The next step of the analysis was to ensure that the data for the basic belief dimensions provided an acceptable fit of the model for each of the strata separately. Table 3 presents the results of structural equation modeling on the basic belief dimensions for each stratum. Results suggested that the data for each separate stratum were a reasonable fit of the proposed factor structure of belief dimensions since most of the fit indices were within an acceptable range. However, the data best fit the basic belief dimensions factor structure for visitors to Mt. Baker–Snoqualmie, where all goodness of fit indices were within acceptable ranges (X^2/df < 5; NFI, CFI, and GFI > .90). For Arapaho–Roosevelt and San Bernardino, the NFI and GFI were all > .90; however, the CFI was .88 and .85, respectively.

Results from the second step of the analysis suggested that there might be differences in the factor structure of the basic belief dimensions across the three strata of the study. Due to the large sample size and the relative similarity of fit indices across the strata, however, the importance of those differences was unclear. We therefore examined differences in specific items associated with each of the wildfire management basic belief dimensions across the three strata. Inter–item correlations for each item and each stratum were converted to Fischer's z-scores and a series of t–tests were conducted to examine bivariate differences. Bonferroni's correction for multiple comparisons resulted in a comparison alpha of .0007. Table 4 presents the results of these analyses.

Analyses of differences in inter–item correlations across the study strata shed light on where factor structure differences occurred. There were no differences across study strata for the anthropocentric, freedom, capable/trust, and benefit/harm dimensions. There was, however, a difference in one of the items for the biocentric scale.

Table 2.—*Factor structure equivalence between and within national forest visitor strata*

	X^2	X^2/df	NFI	CFI	RMSEA
Between national forest visitor strata					
Constrained to be equal among forests	1,115.13	2.69	.90	.90	.07
Allowed to vary among forests	1,031.84	2.71	.90	.91	.07

$\Delta X^2 = X^2$ (equal) – X^2 (varied) = 83.29, $p < .05$

Table 3.—*Goodness of fit of basic beliefs factor structures for each study stratum*

Strata	X^2	X^2/df	NFI	CFI	GFI	RMR
Arapaho – Roosevelt NF visitor	338.76	3.11	.92	.88	.92	.06
Mt. Baker – Snoqualmie NF visitor	272.67	2.50	.94	.90	.94	.05
San Bernardino NF visitor	269.51	2.47	.91	.85	.90	.06

Table 4.—*Corrected item-total correlations of basic belief items for the three national forest visitor strata*

Basic belief dimensions/items	Corrected item-Total correlations		
	Arapao-Roosevelt	Mt. Baker-Snoqualmie	San Bernardino
Biocentric			
• Nature has as much right to exist as people.	.87	.86	.86
• Forests have as much right to exist as people.	.89	.89	.88
• Forests have value whether people are present or not.	.41[a]	.57[b]	.44[ab]
• Wildlife, plants, and people have equal rights.	.73	.68	.73
Anthropocentric			
• The value of forests exists only in the human mind.	.46	.47	.45
• Nature's primary value is to provide products useful to people.	.64	.64	.63
• The primary value of forests today is to provide places to play and recreate.	.39	.43	.50
• The primary value of forests is to provide timber, grazing land, and minerals for people.	.72	.65	.60
• Forests are valuable only if they produce jobs and income for people.	.53	.55	.56
Responsibility			
• Homeowners are the most responsible for protecting their homes, near a forest, from wildfire.	.44[a]	.33[ab]	.21[b]
• When people build homes near forests, it is their own fault if their home is damaged by wildfire.	.43[a]	.47[a]	.21[b]
• When people build homes near forests, they have the right to expect their home will be protected from wildfire by the government agency managing the forest.	.53[ab]	.65[a]	.46[b]
• The community fire department is the most responsible for protecting homes built near a forest from wildfire.	.42[a]	.30[ab]	.24[b]
• The government agency that manages the forest is the most responsible for protecting homes built near a forest from wildfire.	.59	.62	.50
• If a wildfire breaks out in a forest, the first priority of the agency managing that forest is to make sure private property is not destroyed.	.37	.38	.28
Freedom			
• People should be allowed to build homes where they want, even if it is in a high wildfire zone.	.55	.47	.44
• People should not be allowed to build homes near forests where their homes could be destroyed by wildfire.	.67	.62	.63
• Laws should prohibit building homes where they can be burned by wildfires.	.65	.58	.65
Capable/Trust			
• Setting prescribed fires in order to decrease the threat of future wildfire is an appropriate strategy for managing forests.	.67	.59	.56
• Prescribed fire is too uncontrollable to be an appropriate forest management tool.	.73	.64	.66
• Forest managers should not use artificial methods to manage a natural process like forest fires.	.64	.58	.61
Benefit/Harm			
Wildfires in National Forests, Parks, and other natural areas are:			
• Bad/Good	.82	.85	.84
• Harmful/Beneficial	.79	.84	.84
• Negative/Positive	.81	.80	.82

[a, b, c] Superscripts represent significantly different inter–item correlations. Correlations were converted to Fisher's z scores and t-tests were conducted. Bonferroni's correction for multiple comparisons resulted in a p-value < .0007.

The inter–item correlations for the item "forests have value whether people are present or not" was significantly higher for the Mt. Baker–Snoqualmie stratum (r = .57) than for the Arapaho–Roosevelt (r = .41) and San Bernardino (r = .44) strata. Mitigating this difference, however, are the high reliabilities of this dimension for all strata (Arapaho–Roosevelt α = .85, Mt. Baker–Snoqualmie α = .87, San Bernardino α = .86). The most striking differences were found for the responsibility basic belief dimension. Four of the six inter–item correlations for the San Bernardino stratum were significantly lower than for one or both of the Arapaho–Roosevelt and Mt. Baker–Snoqualmie strata. Comparing the reliabilities of this dimension across the three strata supports these findings. While the items making up the responsibility dimension showed relatively high reliability for the Arapaho–Roosevelt (α = .73) and Mt. Baker–Snoqualmie (α = .72) strata, the reliability for this dimension in the San Bernardino stratum was .57.

DISCUSSION

Conclusions

In this paper, we described the process of identifying and validating scales for measuring basic beliefs related to wildfire management. Basic beliefs are closely tied to fundamental values (Rokeach 1973) and have been found to be effective in orienting one's fundamental values to specific issues where one's attitude and behavior are of interest to natural resource managers. The use of basic beliefs and value orientations in the value–attitude–behavior hierarchy has increased recently, particularly in the field of wildlife management, and presents a more complete picture of the cognitive structure underlying or driving behaviors.

Several conclusions are suggested by this exploratory research into the existence of basic beliefs about wildfire and its management. First, different basic beliefs appear to exist for wildfire management. Results of the pre–test structural modeling and analysis of data across visitors to the different national forests supported the notion that the public thinks about wildfire management in terms of dimensions described as biocentric, anthropocentric, freedom, capable/trust, responsibility, and benefit/harm. It is important to point out that this research does not suggest these are the only basic belief dimensions that exist for wildfire management. Yet these results demonstrate that these dimensions exist. Modification to these scales or the addition of other basic beliefs is possible.

Second, the structure of the basic belief dimensions regarding wildfire management examined in this study was relatively consistent across the different strata. This is especially true of the biocentric, anthropocentric, freedom, capable/trust, and benefit/harm dimensions. The similarity across the different geographically based strata suggests an ability to use these scales across a diversity of populations.

The responsibility basic belief dimension appeared to be somewhat different across national forest visitor strata, particularly for the San Bernardino National Forest in California. While we cannot specifically identify the reason for this difference, it does suggest that the items for this basic belief dimension require additional work in order to be more universal in application.

Future Research

Future research is necessary in several areas related to this work. First, the responsibility basic belief dimension needs to be refined. Additional items should be explored for this dimension as well as changes in existing items. Work on the other basic belief dimensions developed in this study should also continue to enhance the content and construct validity of the scales.

Second, work should continue to identify additional basic belief dimensions that orient fundamental values toward fire management. The dimensions identified in this study are not likely to be the only ones that can be measured related to wildfire management. Increasing the number of viable basic belief dimensions can enhance the usefulness of this information to fire managers considering a variety of specific wildfire management strategies or policies.

Third, while this paper addresses the content and construct validity of the basic belief scales, the scale's usefulness to forest managers will increase if the predictive validity of the scales is assessed. To what extent do basic beliefs, or their orientation, predict specific attitudes toward fire management policies or norms for acceptable

agency reactions to wildfire? The predictive validity of the value orientations to wildfire management is being assessed in another aspect of the study described herein.

Finally, while fundamental values do not differ greatly within a society, the orientation of those values, measured using basic beliefs, may differ. Additional research should examine factors that are correlated with such differences. For example, do people who live in the Western U.S. hold different basic beliefs about wildfire management than people in the Eastern U.S.? Do age and life stage influence basic beliefs about wildfire management? Does residence (urban versus rural) or the type of home ownership (primary versus second home ownership) influence basic beliefs and the orientation of values toward wildfire management? Research on wildlife basic beliefs and value orientations has supported the notion that there are differences across segments of society and that these differences do predict preferences for specific wildlife management actions. It is reasonable to suspect that the same differences can be identified regarding perceptions of wildfire management.

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INDIGENOUS AND TRADITIONAL USE OF FIRE IN SOUTHWESTERN GRASSLAND, WOODLAND, AND FOREST ECOSYSTEMS

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ABSTRACT.—Two projects funded under the National Fire Plan include examinations of historic, ethnographic, and archeological information on the use of managed fire by both indigenous and traditional communities (such as the Hispanic farmers and ranchers of northern New Mexico) in the grassland, woodland, and forest ecosystems of the Southwest. These data provide a background framework for understanding contemporary fire management views, attitudes, and practices among these communities, and they provide a valuable body of information to contemporary land managers. Important past fire uses include clearing agricultural land, replenishing soil nutrients, managing natural vegetation, hunting and driving game, and waging war.

Research in the Southwest conducted under the National Fire Plan is examining the use of managed fire among contemporary and historic American Indian, Hispanic, and Anglo-American communities, and the ways in which their burning practices differ from those of contemporary land management agencies. This research will provide background information to land managers and the public to help them understand the values, attitudes, and preferences of these communities concerning prescribed fire use and management in the grassland, woodland, and forest ecosystems of the Southwest. One of the projects examines the role of fire in southwestern grasslands in managing exotic and woody plants, with the goal of restoring fire as an ecological process in the grasslands. The other gathers information on community knowledge, beliefs, attitudes, and practices concerning fire and fuels management in southwestern forest and woodland ecosystems, providing a database to assist land managers in working more effectively with local communities. For purposes of this research, the Southwest is defined in terms of the USDA Forest Service's Region 3: Arizona, New Mexico, and portions of western Oklahoma and the Texas Panhandle. The portion of the research results discussed in this paper comes from a literature review of published historic, ethnographic, and archeological sources concerning burning by historic groups in the region.

LITERATURE REVIEW OF HISTORIC BURNING

There is a growing body of information describing American Indian use of fire; there is also considerable information on the use of fire by traditional farming and ranching groups, such as the Hispano and early Anglo communities of the Southwest. In the view of Williams expressed in reviews and an annotated bibliography of American Indian use of fire in ecosystems (2001a, b) and in reviews by Pyne (1982, 1995), burning by American Indian groups has modified landscapes across the continent. Other proponents of humans as primary fire-inducing agents in pre-fire-suppression times include Dobyns (1981), Kay (1994), Lewis (1973, 1985), and Stewart (1955a, b). Since there were no written records of burning by indigenous groups prior to European settlement, these fires were often interpreted as natural by early explorers and settlers. Many contemporary scientists studying pre-European-settlement fire evidence also tend to attribute most prehistoric fires to natural causes. An especially strong case for the primary role of natural causation in the form of lightning ignitions in the upland Southwest was made by Allen (2002); other

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useful treatments of this topic were presented by Adams (in press), Fish (1996), Swetnam and Baisan (1996), and Touchan and others (1996). Periman (2001) discussed the growing role and importance of landscape archeoenvironmental studies in clarifying and understanding burning regimes before European contact. The present review does not focus on the issue of natural versus human causation for historic-era, landscape-scale burning, but simply covers the available literature on indigenous and traditional use of fire in the Southwest, which has had considerably less review than other geographic areas (Allen 2002).

Both primary and secondary accounts describe purposeful burning by American Indian groups in various parts of North America to promote diversity of habitats and resources, environmental stability, predictability, and maintenance of ecotones (Lewis 1985; Williams 2001a, b). These purposeful fires can differ from natural fires on the basis of seasonality (season of burning), frequency, and intensity. Groups burned in the late spring before new growth appeared and, in drier areas, in late summer or early fall prior to the main winter growth period (Lewis 1985, Williams 2001b). According to Pyne (1982), the American landscape was modified by American Indian groups using repeated, controlled surface burns on cycles of 1 to 3 years in some areas, broken by holocausts from escaped fires and conflagrations in drought years. Many of the grassland areas found by European settlers were created or maintained by American Indian burning. Many forested areas were kept free from underbrush by indigenous fire regimes (Pyne 1982). However, see Allen (in press) for the contrasting view that these conditions were maintained in most cases by naturally occurring fires sparked by lightning ignitions, at least in the ponderosa pine uplands of the Southwest.

In a 1973 study, Lewis listed 70 reasons for American Indian burning of vegetation. Kay (1994), Russell (1983a, b), and Williams (2001b) also compiled lists of the various reasons indigenous groups used fire. From his extensive literature review of over 300 studies, Williams (2001b) summarized 11 major categories of fire use: hunting, managing crops, improving growth and yields of wild plants, fireproofing areas around settlements, collecting insects, managing pests, waging war, extorting trade benefits from settlers and trappers by depriving them of easy access to big game (scorched earth policy), clearing travel routes, felling trees, and clearing riparian areas. The majority of the studies that produced this information were derived from research in the Pacific Northwest, California, the Northeast, the Midwest, and forested areas of Canada (review of annotated bibliography, Williams 2001b).

FIRE USE BY HISTORIC AND PRE-CONTACT GROUPS IN THE AMERICAN SOUTHWEST

Thus, although there is a substantial amount of information on American Indian fire use, research is still needed in the Southwest, especially in the grasslands. To meet this need, a literature review was conducted by Condie (unpublished paper) to examine historic, ethnographic, and archeological sources on the use of managed fire by groups in the region. Fires used for land and vegetation management or those that might have landscape-scale effects were considered. Groups studied included the American Indians, Hispanics, and early Anglo-American settlers of the area. Research was conducted on the following American Indian groups: Eastern and Western Pueblos, Apache, Navajo, Comanche, Ute, Kiowa, Cheyenne/Arapaho, Southern Paiute, and Manso-Suma-Jano-Jocome.

The literature review of between 400 and 500 sources found no information on fire use as a land and vegetation management tool for the Kiowa or the Cheyenne/Arapaho. Uses were identified for all the other groups. Owing to researcher familiarity and proximity, major New Mexico groups and their literature were emphasized, with review of considerable numbers of sources on the Pueblos, Apache, and Navajo. Fewer sources were found for the other groups. In some cases, such as the Manso, very little literature exists. This review identified nine primary reasons for intentional burning of vegetation (Condie, unpublished paper), which are discussed in the following sections (table 1). Burning for agricultural purposes is covered first.

Table 1.—*Uses of fire by American Indian, Hispano, and early Anglo-American settlers in the Southwest*

1. Clearing land for agricultural fields and pastures
2. Replenishing soil nutrients in agricultural fields
3. Killing woody species in rangelands
4. Encouraging grass growth
5. Increasing wild seed production
6. Stimulating shoot formation (producing straight shoots for basketry and production of other implements)
7. Improving growth of both wild and cultivated tobacco
8. Driving and hunting game
9. Waging war

Clearing Land and Agricultural Fields and Replenishing Soil Nutrients

Archeological evidence is fairly convincing (Petersen 1985: 238, Petersen and Matthews 1987: 7), and historic and ethnographic evidence is well documented, for aboriginal use of fire in clearing agricultural fields. Puebloan groups such as the Zuni and Santa Clara cleared fields by piling sagebrush, grass, and weeds in the middle of the field and burning them (Cushing 1974: 152-153, Hill 1982: 27). Apache and Navajo prepared fields by burning the grass and brush. Bushes, weeds, and tall grass were pulled out and burned (Opler 1971: 233, Opler 1973: 44). Hill (1938: 24) observed that Navajos "burned over [fields] to remove as much brush and tree growth as possible." The Hispanos of the region also used fire as a means of clearing timbered farmland and land for pasture. "Third-generation shepherd Leandro Salazar recalled his father telling of fires set by shepherds to enlarge pastures in the northeastern Jemez Mountains in the late 1800s that created meadows still present today" (Allen 1984: 131-132). After further research, Allen (in press) noted that fire scar data from the area does not indicate fall burning, which would presumably be the time when shepherds fired pastures as they left for the winter. Thus, the fire scar information is inconsistent with Salazar's claim or the shepherds were burning during some other season. Further research is needed on questions such as these, with other lines of evidence brought to bear on inconsistencies between historical information and fire scar information. Archeoenvironmental studies may prove helpful in this regard (Periman 2001).

Burning of agricultural fields was also used as a technique for replenishing soil nutrients. Sources indicate that Apaches commonly used fire to remove stubble in fields and produce nutrient-rich ash (Scurlock 1998: 269). A White Mountain Apache man said that his people would burn grama grass on fields because it was good for corn, but weeds and cornstalks were only fired at the edges of fields and ashes were not scattered on the field (Buskirk 1986: 25, 61). On the other hand, farmers from Zia used wood ash in their fields for fertilization, placing ash around the corn plants when they were about 1.5 feet high (Euler 1954: 29).

Managing Natural Vegetation

A variety of burning activities fall under the rubric of managing natural vegetation, with killing or suppressing encroachment by woody species and encouraging new grass growth at the top of the list. Also included are increasing wild seed production, stimulating shoot formation, and improving the growth of both wild and cultivated tobacco. Taken together, these activities would have the potential to affect relatively large areas. According to Williams (2001b: 2):

> Early explorers and fur trappers often observed huge burned over or cleared areas...without knowledge of whether the fires were natural or Indian caused. Written accounts by early settlers remain incomplete, although many noted that there was evidence of burned or scorched trees and open prairies or savannas with tall grasses in every river basin...There are many other accounts of travelers in forest areas commenting on the ability to see through/around the trees for long distances—obviously lacking in shrubs, brush, and small trees.

Clearing Land of Woody Species and Encouraging Grass Growth

Into the turn of the 20th century, European settlers also used fire to clear land of brush and trees both to create new farmland and to maintain grassland areas free from encroaching tree growth for pasturing domesticated animals. Since many upland grazing areas were public domain in the late 1800s and early 1900s, settlers near these lands were reported to either deliberately set fires or allow wildfires to burn in these areas (Williams 2001b: 2). Gibson (1967: 150) commented that ranchers in eastern New Mexico, western Oklahoma, and western Texas set grass fires accidentally or deliberately. Sheep and cattle ranchers were also described as setting mountain meadows on fire at the end of the season to burn off dried grass and brush. These fires also killed young trees and encouraged new grass growth for the following season (Williams 2001b: 2). Pratt and Scurlock (1989: 100) discussed Hispanic and Anglo cattle ranchers in southeastern New Mexico burning rangelands to kill mesquite and other woody invaders, and ranchers in Texas and southeast New Mexico burning off pastures to produce new grass (Stewart 1955a: 63). Stewart (1955a: 63) noted that grass can be inadequate to carry a fire hot enough to kill mesquite shoots in overgrazed pastures, resulting in a takeover by the mesquite.

Various Plains Indian groups burned grass near their villages to improve grazing for their horses and encourage the buffalo to come near (the villages) (McHugh 1972: 70). They burned to create a new crop of grass and make passage easier for people and horses the following year (Stewart 1955a: 59). People from Taos were also reported to set fire to grass in the spring to encourage new growth (Brugge and Gerow 2000: 475, quoting Dominguez 1776 from Adams and Chavez 1956). Several of the Plains groups had restrictions against burning sparse, short grass, because the initial increase in forage would be followed by a decrease in overall yield (McHugh 1972: 70). In a study of wildfires in southeastern Arizona and southwestern New Mexico, Bahre (1985: 190) examined newspaper records from 1859 through 1890. Some of his conclusions include the following:

1. American Indians, especially the Apaches in the area, set wildfires.
2. Wildfires were much larger in areal extent in the grasslands than they are at present.
3. The occurrence of large grassland fires declined after 1882, probably as a result of overgrazing. In addition, early Anglo settlers favored wildfire suppression.
4. The cessation of major grassland fires preceded the brush invasion of the 1890s.

Increasing Wild Seed Production and Stimulating Shoot Formation

The Zuni, Apache, Navajo, and Ute were reported to burn patches to improve wild seed production (Gifford 1940, Stewart 1942). In addition to increasing seed production, several researchers inferred that prehistoric groups burned sumac and probably willow to produce straight shoots for basketry, cradle boards, arrow shafts, and other implements (Bohrer 1983, 1992; Dunmire and Tierney 1995). Bohrer combined several lines of evidence to suggest prehistoric burning of squawbush (1983: 122):

> The use of the straight shoots of squawbush for split-twig figurines in the Late Archaic provides suggestive evidence of the long use of fire to manipulate vegetation in the Southwest. Although our knowledge of formalized burning practices among Pueblo agriculturalists has been preserved erratically, an attitude toward fire as a fertile force still persists in ritual contexts.

Ethnographic evidence indicates that the Apache burned trees (probably willow and sumac) to stimulate the growth of shoots for basket making (Buskirk 1986: 165-166), while the Apache, Comanche, and probably the Suma and Manso, burned grasslands and upland shrublands, woods, or forests to stimulate new plant growth (Scurlock 1999: 91). The Hispanos of the Middle Pecos area also used fire to encourage the growth of denser and taller plants (Scurlock and Parsons 2001: 21).

Improving the Growth of Wild and Cultivated Tobacco

Adams and Toll (2000: 144-145) suggested that burning is necessary to keep tobacco growing. They described the response of the plant to a lightning-caused fire in southwestern Colorado, with 86 plants present in the area the first summer after the burn. This number had dropped to zero by the third summer after the burn. Since tobacco remains are present in archeological sites, these authors

inferred that prehistoric people may have fired tobacco patches to encourage growth. Historically, Apache, Navajo, Ute, and Southern Paiute burned patches of wild tobacco and locations that would be used for cultivated tobacco to improve growth and productivity (Buskirk 1986, Opler 1971, Stewart 1942). For the Navajo, Southern Ute, and Ute Mountain Ute, Stewart (1942: 251, 300) reported both purposeful burning and recognition that burning improved the crop. Among the Ute Mountain Ute, the burner of the tobacco plot was recognized as the owner. As Fowler observed for Great Basin groups (1986: 93): "Burning to increase natural yields of tobacco is the best attested procedure among all groups...In areas where it appears not to have been practiced, groups nonetheless recognized the association between tobacco yields and fires, frequenting naturally burned areas to harvest the plants."

Driving and Hunting Game

Puebloan groups (reported for the Zuni and Santa Ana), Apache, Navajo, Comanche, Ute, and Southern Paiute, as well as Hispanics, used fire in game drives and surrounds (Cooper 1960, Curtis 1926, Gifford 1940, Hill 1938, Hough 1926, Jones 1932, Kelly 1964, Pratt and Scurlock 1989, Stevenson 1881, Stewart 1942). Rabbit, deer, antelope, and other game were driven, as were insects such as cicadas, crickets, and grasshoppers. As described for the Apache, "...fire was used as an aid, a large segment of a circle being fired while a line of men closed off the unfired gap. Rabbits were killed with arrows or with yucca-stalk clubs about six feet long. One informant stated that a fire circle might be a mile in diameter; another had seen brush level areas one-half by one-quarter of a mile in size fired." (Buskirk 1986: 135-136).

In 1796, Lieutenant Colonel Don Antonio Cordero described large Apache hunts for "deer, burro, antelope, Jav[e]lina, porcupine, mountain lion, bear, wolves, coyotes, hare and rabbits." By dawn, hunters stationed over an area 12 to 15 miles in circumference would, on signal, ride toward the center setting fire to grass and shrubs as they converged. "...It takes only a moment to see the whole circle flare up. At the same instant the shouts and noise commence, the animals flee, they find no exit, and finally they fall into the hands of their astute adversaries." This method is used only in late summer or fall when grass is dry (Matson and Schroeder 1957: 343-344). Stewart (1942: 242) and Hill (1938: 177) described Navajos driving rabbits with a circle of fire. Stewart (1942: 240, 242, 245) stated that Southern Ute and Ute Mountain Ute drove deer and elk with fire and burned thick brush to drive rabbits out; Southern Ute drove cicadas, crickets, and grasshoppers with a circle of fire. Cooper (1960: 138) remarked that Powell (1879) "...stated that Indians systematically set fire to the forest for the purpose of driving game. The early pioneers of Kanab, Utah, saw great clouds of smoke rolling over the Kaibab Plateau almost continuously from late spring to early fall." However, it is unknown if this description comes from especially dry years or if all observed fires were from human ignitions.

Dobyns (1981: 28) asserted that "Fire constituted the principal technology that Indoamericans possessed for modifying natural environments in order to augment their food supplies," and devoted considerable effort to demonstrating that Apaches and other Indians in the Sonoran Desert drove game with great frequency by firing the landscape (1981: 24-43). It is worth noting, though, that after reviewing Kaib's (1998) detailed examination of Apache fire use in the US/Mexico borderlands, Allen (in press) concluded that Kaib's (1998: 140) evidence indicates localized fire use for small game drives, but not the widespread fire-drive hunting among the Apaches described by some researchers (Dobyns 1981, Pyne 1982, as examples). The historic and ethnographic sources indicate that hunting with fire drives was certainly undertaken, but its landscape-scale impact should not be a foregone conclusion. Over time, however, these small-scale fires can create a patchwork mosaic at the landscape scale (Periman, personal communication).

Waging War

Using fire as a means of waging war is well documented both before and after European contact. Kaib (1998) found that about 80 percent of historical references to intentional fires were in the context of warfare. Virtually all of the groups examined used fire against their enemies for purposes of escape, flushing out adversaries, and burning habitations, forage, and belongings. Archeological evidence of areas with significant numbers of severely burned sites is seen as the use of fire to burn out enemies in pre-contact times. Studies in northwestern New Mexico

seem to indicate that prehistoric people repeatedly fired villages of presumed enemies during certain periods (AD 1150-75 and 1275-1300, for example). Of 300 recorded sites in the area southwest of Cuba, NM, over 95 percent have been burned (Lally, in preparation; Lutonsky, in preparation). In a nearby area to the south, 83 percent of the 84 recorded sites were burned (Shiffler, in preparation). In historic times, the Apache and Navajo used fire to drive away enemies, burn forested areas used by enemies, or escape from enemies in clouds of smoke (Scurlock and Parsons 2001). The Comanche set fire to the grass to cover their trail from pursuing men and dogs, and Dobyns (1981: 35) notes that the Hispanos set fires to burn out opposing warriors.

CONCLUSIONS

Table 2 presents a brief summary of fire use by group. Nearly all the studied groups used fire to drive game—most especially the Apache, Navajo, Ute, and Southern Paiute. Puebloan groups also used fire drives, but they were apparently less extensive and less frequent. Use of fire in warfare occurred both prehistorically and among historic groups. Generally more limited and controlled fire was used to clear land, stimulate shoot formation, encourage new grass, increase seed production, improve tobacco, and increase soil nutrients. The research shows that people were quite cognizant of the use of fire as a management tool and understood its ecological effects, using it for specific, limited purposes. The sources indicate that the history of fire use in the Southwest is long, stretching well back before European contact. In certain times and places aboriginal and historic fire use had the potential to create landscape-scale environmental effects, but the role and effects of human-induced burning should not be automatically assumed. Much southwestern burning, especially in the ponderosa pine uplands, is apparently the result of the frequent lightning strikes in the area. Smaller scale, more limited environmental effects from human induced burning are probably the norm. Indeed, the most important human effect before European contact may have been the absence of advanced fire suppression technology, which did not come to the fore until the 20th century.

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Table 2.—*Fire use in the Southwest by ethnic group*

	Prehistoric	Pueblo	Apache	Navajo	Cheyenne/ Arapaho	Comanche	Kiowa	Ute	Southern Paiute	Manso/Suma/ Jocome/Jano	Hispanic/Anglo	Totals
A. Clear land	+	+	+	+	-	-	-	-	+	-	+	6
B. Stimulate shoot formation; encourage new growth	+	-	+	-	-	+	-	-	-	+	+	5
C. Encourage new grass*	-	+	+	-	-	-	-	-	-	-	+	3
D. Replenish soil nutrients	-	+	+	-	-	-	-	-	-	-	-	2
E. Increase seed production	-	+	+	+	-	-	-	+	-	-	-	4
F. Improve tobacco	+	-	+	+	-	-	-	+	+	-	-	5
G. Kill mesquite and other woody invaders	-	-	-	-	-	-	-	-	-	-	+	1
H. Drive game**	?	+	+	+	-	+	-	+	+	+	+	8
I. Wage war	+	+	+	+	-	+	-	+	-	-	+	7
Totals	4	6	8	5	0	3	0	4	3	2	6	

Note: + indicates trait present, but – indicates that no information was found (does not indicate trait absent).
*Unspecified Plains groups burned to encourage grass.
**Unspecified Plains groups (probably northern) hunted buffalo with a fire surround.

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ASSESSING PUBLIC TRADEOFFS BETWEEN FIRE HAZARD AND SCENIC BEAUTY IN THE WILDLAND-URBAN INTERFACE

Terry C. Daniel, Ed Weidemann, and Dawn Hines[1]

ABSTRACT.—Wildfire risk management efforts have historically emphasized prevention of ignitions or, failing that, rapid suppression. Currently emphasis is increasingly being placed on preemptively managing the fuels that feed catastrophic wildfires. Support for fuel reduction strategies hinges on public perception and evaluation of a complex set of tradeoffs among uncertain and potentially conflicting values. For example, if at-risk publics fail to perceive the hazard represented by existing (or projected) vegetative fuels, while perceiving the aesthetic consequences of proposed fuel management treatments to be substantial and negative, they are unlikely to support that treatment. The research reported here explored public perception and evaluation of fire hazard/aesthetic value tradeoffs represented by alternative fuel reduction treatments. In particular, relationships were investigated between changes in natural vegetative fuels and public perceptions of scenic beauty and fire hazard in hypothetical forest homesites.

The "wildfire problem" in North America has existed since the first settlers built their homes in the untamed woods. Using loss of human life as the gauge, the worst recorded wildfires in North America occurred over a century ago (www.nifc.gov/stats/historicalstats.html). Loss of life to wildfires is relatively rare today, due mostly to improvements in fire protection capabilities, but wildfire remains a significant natural hazard. *Wildfire risk* can be defined as the *value* of lives, property, and environmental resources exposed ("at risk") multiplied by the *probability* of the occurrence of a fire of sufficient intensity to cause damage or loss (the "hazard level"). Human development has dramatically expanded in and near fire-prone forest environments—creating the *wildland-urban interface* (LaGro 1994). Previous fire suppression policies have increased the store of flammable fuels, making high-intensity fires more likely (Vogl 1971). These two factors have combined to make wildfire risk in North America higher now than ever before (FEMA 1992, NFPA 1991, NWCG 2001, Winter and Fried 2000).

Professional recognition of the heightened wildfire risk is indicated by intensified national public awareness and action campaigns (such as "Wildfire Strikes Home!," www.firewise.org) and by the growth of multiagency protection programs (www.nifc.gov). The dramatic fires of 2000-2002 have brought intense national media attention and increased public awareness and concern. But wildfire risk has not typically been much appreciated by the public (e.g., Cortner *et al.* 1990, Gardner *et al.* 1987, Taylor *et al.* 1986, Winter and Fried 2000), and concern will likely decline to prior low levels soon after rains drive forest fires from the headlines. Agencies charged with protecting people's lives and property, and with protecting the environments in which they live and recreate, will again struggle to gain and sustain public support for more effective wildfire risk management.

Historically, wildfire risk management efforts have emphasized prevention of fire ignitions ("Smokey Bear") and, when fire prevention fails, aggressive fire suppression ("10:00 a.m." policy). Public support for fire prevention has been relatively easy to obtain, in part because the rationale is immediately evident—if wildfires don't start, there will be no damage. Fire suppression, although

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notoriously expensive and frequently dangerous (firefighters are the most likely human fatalities in a wildfire), has also garnered high levels of public support. The rationale for fire suppression is also clear and compelling—when a wildfire is burning, put it out.

Increasingly the professionally preferred management strategy is to preemptively control the intensity and magnitude of wildfires by reducing the vegetation that fuels the fire. But public support for managing wildfire risk by reducing fuels is likely to be difficult to obtain, and to sustain. Fuel reduction treatments, such as mechanically removing flammable vegetation, are rather too similar in means and ends to "timber manage-ment" activities that already have considerable negative connotations. An assumption not readily expelled is that cutting in the forest for whatever purposes will produce a less aesthetic, "unnatural" landscape. The alternative of reducing fuels by "controlled burning" also conjures up less than appealing landscape images (especially in the short term, e.g., Anderson *et al.* 1982, Taylor and Daniel 1984), and fire is still not widely accepted as a potentially benevolent natural process (e.g., Stekel 1995, Taylor and Mutch 1985). Further, the highly publicized instances where the "control" part of the process was not fully achieved have added further uncertainty and have made many fear the "cure" as much as the "disease." The logic of protecting the forest from wildfire by cutting it down or burning it in advance (some of it at least) is neither as direct nor as compelling as the rationales for prevention or suppression. Moreover, fuel reduction treatments must be regularly repeated/maintained if they are to live up to their promise of reduced losses if and when a fire occurs. Thus, supporting fuel reduction strategies requires sustained support from the public, and acceptance that there will be a fire—so long as there is no wildfire, the safety benefits of fuel reduction cannot be realized.

Support for wildfire risk management strategies in the wildland-urban interface hinges on public perception and evaluation of a complex set of tradeoffs among uncertain and potentially conflicting values (e.g., Renn and Rohrmann 2000, Rohrmann 1996). Certainly no one wants to be injured or to lose property to a wildfire. But people do want to continue to enjoy the beauty of what they perceive as natural landscapes and the opportunity to experience wildlife in their "natural" settings. If at-risk publics fail to perceive the vegetation that adorns their beautiful landscapes as a potential hazard, they are unlikely to support actions for reducing these "fuels." If, in addition, people perceive the effects of removing vegetation as damaging to aesthetic and natural environmental values, they will be even less likely to support fuel management strategies. Much is known about the effects of forest vegetation on public perceptions of aesthetic values (e.g., Brown and Daniel 1986, Brunson and Shelby 1992, Brush 1979, Buhyoff and Leuschner 1978, Ribe 1990, Schroeder and Daniel 1981, Vining *et al.* 1984). Little or nothing is known about people's perception of the hazard represented by vegetative fuels. The research reported here explored public perception of fire hazard x aesthetic value tradeoffs in fire-prone forest environments. In particular, the study focused on relationships between vegetative fuel conditions and public perceptions of natural scenic beauty and wildfire hazard for hypothetical homesites in southwestern ponderosa pine forests.

METHOD

Sets of digital images were developed to represent views from hypothetical forest homesites in a Web-based perceptual survey. Vegetative fuel conditions depicted ranged from very high to very low fire hazard. Separate groups of observers independently rated each site for *scenic beauty*, *fire hazard*, or overall *preference* (as a forest homesite). A fourth group rated the same sites on all three scales, providing a within-subject replication of the experiment. Rating scale data were subjected to ANOVA and multiple regression analyses to determine the separate contribu-tions of aesthetic and hazard perceptions to overall home-site preferences.

Study Sites

Study sites were selected from a large set (over 2,000) of southwestern ponderosa pine forest plots on the Coconino National Forest in northern Arizona. Plots were originally inventoried and photographed between 1979 and 1982 (Brown and Daniel 1984, www.fs.fed.us/rm/value/research_forest_scenic_beauty.html#modeling). Each plot was centered around a sample point along a linear transect within a forest "stand," as delineated by professional Forest staff. A comprehensive biological inventory (overstory, understory, downed wood, groundcover) was collected for each plot, and four color slides (90-degree separation) were taken from each plot center

to represent visual features. Slides were subsequently commercially digitized and stored as compressed high-resolution JPEG files to be displayed as photographically realistic color images (768 x 512 pixels, 16 bit color) on computer monitors.

Bio-physical data for each plot were entered into an appropriate fire behavior model to estimate fire hazard levels (ratio of projected flame heights to inventoried ground-to-crown heights) for each plot, assuming "extreme" fire weather conditions.[2] The 50 hypothetical homesites used in the current study were selected to represent the range from lowest (0.00) to highest (2.22) model-projected fire hazard (10 sites per quintile), subject to image/photographic quality constraints. The distribution of fire hazard indices for the study sample (and even more so for the full set of plots assessed) was positively skewed, with most values being below 1.00.

Study Participants

Subjects were all undergraduate college students meeting research participation requirements for an introductory psychology class. Experiment availability was advertised by a standard announcement posted among dozens of other experiments. A total of 138 subjects, participating in groups ranging from 3 to 15 (depending upon voluntary signup rates), reported to a multi-station computer laboratory. Each subject was assigned to an individual PC workstation, where each independently and interactively viewed instructions and responded to the 50 hypothetical homesites and to a small set of verbal followup questions. For the between-S conditions of the experiment, all subjects appearing for a given experimental session were assigned to the same rating scale (*scenic beauty*, *fire hazard*, or *preference*), so that any questions about procedures would not expose the other rating conditions in the experiment. Similarly, subjects in the within-S condition were run separately. No record was kept of subject ages or gender, but there was no indication of any important variation from typical undergraduate student demographics.

Web-based Perceptual Survey

The Web-based survey procedure allowed multiple subjects to participate at the same time. While this method allows participation from anywhere on the World Wide Web, all subjects in this study participated under experimenter supervision in a computer laboratory. Each subject logged onto the appropriate form of the survey (rating condition) and then proceeded independently in a self-paced procedure to read instructions, observe preview images, and respond to the 50 homesites and 3 verbal followup questions. The followup questions addressed the subjects' evaluation of the quality of the visual representations (digital images) presented, their confidence in the validity of their ratings (viz. how they would respond if actually at the forest sites represented), and their judgment of the importance of fire hazard (relative to aesthetic values) in the selection of a forest homesite. The first two questions were relevant to components of a larger study not reported here.

Each homesite was represented by four individual views/scenes, which the subject interactively accessed in a self-paced procedure, subject to image loading and other computer-system imposed time constraints. After each of the four views of a homesite had been selected and presented at least once, the subject recorded his/her rating (on the assigned scale) for that homesite, based on all four views, and then proceeded to the next homesite. The order of the 50 homesites was individually randomized for each subject, and ratings and answers to followup questions were auto-matically ordered and entered into a relational database. After all 50 homesites were rated and the followup questions answered, a screen thanked the subject for his/her participation. A brief description of the purposes of the study was then presented. Most subjects completed the survey procedures in approximately 30 minutes.

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[2] The Crown Fire Assessment for Fuels Managers (version 0.16 by Donald Carlton, February 16, 2000) was arranged by Tom Brown, Rocky Mountain Forest Experiment Station, and applied with assistance from Sarah Gallup, Arapaho/Roosevelt National Forest. Extreme fire weather was defined by fuel moistures for woody (2-4%, depending on diameter), herbaceous (60%), and shrub (60%) fuels, with wind speed (at fuel level) at 15 mph. All sites were essentially flat, so slope-based hazard parameters were not considered.

Rating Scale Conditions

The hypothetical homesites were all rated for *scenic beauty (SB)*, *fire hazard (FH)*, and overall *preference (Pre)*. General instructions to all groups emphasized that advances in computer and communications technologies were supporting development of a dispersed workplace in which residential choices might be largely unconstrained by geography. In that context it was reported that increasing numbers were choosing to live in rural areas, especially forests, because of the scenic beauty, naturalness, privacy, and other benefits afforded there. It was also noted that these same areas are subject to significant hazards, especially wildfire. In short, the general instructions established the fire-prone "wildland-urban interface" as the setting for the "homesites" to be evaluated.

For the between-S conditions of the study, subjects were instructed to evaluate sites on the dimension (scale) to which they were assigned, with no reference to the other dimensions. *Scenic beauty* was defined in terms of "natural beauty" and "visual aesthetic quality" of the forest landscape. *Fire hazard* instructions included a brief description of how the volume/density and distribution ("ladders") of vegetative fuels affect wildfire behavior (intensity). Subjects were instructed that, for this experiment, it should be assumed that other factors (fuel moisture, wind speed) were in extreme hazard states, as could be expected to occur frequently in such sites. Overall *preference* instructions emphasized the tradeoffs between aesthetic values (scenic beauty) and hazards (wildfire) in forest areas. Subjects were asked to evaluate the homesites based on their own assessment of the relative importance of these factors, with all other factors (access, quality of home and utilities, proximity to lakes and other amenities) assumed equal. For the within-S replication of the study, the separate instructions for each rating scale condition were consolidated, emphasizing tradeoffs between scenic beauty and fire hazard. Subjects were instructed to rate each homesite on all three scales before proceeding to the next homesite.

RESULTS

As shown in table 1, subjects in all experimental conditions produced internally reliable ratings. All conditions achieved reliability coefficients above .85, and most were above .90. Reliabilities tended to be slightly lower for scenic beauty ratings and higher for fire hazard ratings, for both between- and within-S conditions.

Table 1 also shows relevant correlations among ratings for all three scales. For both between-S and within-S conditions, SB x FH correlations were moderate and negative, while SB x Pre correlations were high and positive. FH x Pre correlations were moderate and negative for all conditions, but were somewhat lower in magnitude for the within-S group. Between-S x within-S correlations for the same rating scales were consistently high and positive.

Table 1.—*Perceptual rating reliabilities and inter-scale correlations for all experimental conditions (number of observers)*

	Rating scale condition	Group internal reliability coefficients	Correlation FH	Correlation Pre	Correlation within-S same scale
Between-S	**SB (36)**	.856	-.563	.827	.827
	FH (32)	.947		-.836	.946
	Pre (31)	.915			.819
Within-S	**SB (39)**	.885	-.427	.928	
	FH (39)	.936		-.637	
	Pre (39)	.901			

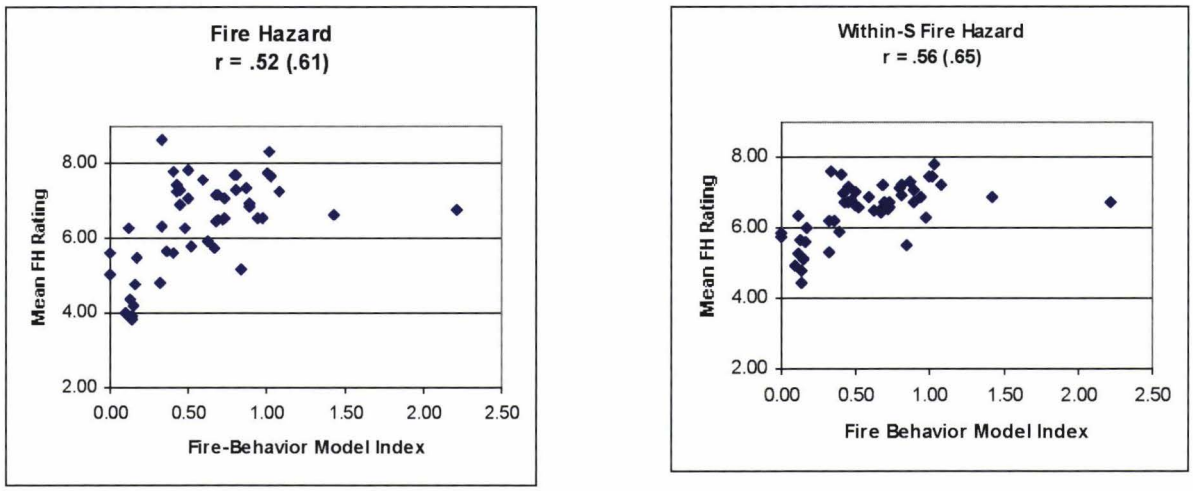

Figure 1.—*Comparison of rated fire hazard with fire behavior model-estimated hazard for between- and within-S groups.*

Figure 1 shows the relationship between perceptual ratings of fire hazard and the model-estimated fire hazard index. Both between- and within-S groups showed moderate positive relationships (improved slightly by dropping the obvious outlier at index = 2.22).

Multiple regression analyses (table 2) revealed that overall *preference* for hypothetical homesites was predicted quite well by *scenic beauty* and *fire hazard* for both between- and within-S conditions (R^2 = .87 and .93, respectively). All regressions forced entry of both FH and SB ratings as independent variables predicting Pre as the dependent variable. Mean preference ratings in the between-S conditions were fit by a balanced equation combining scenic beauty (β = .50) and fire hazard (β = -.55). Within-S conditions, where tradeoff implications were most salient, showed stronger weighting of scenic beauty (β = .80) over fire hazard (β = -.29).

The third verbal followup question asked subjects to estimate how important fire hazard would be (relative to scenic beauty) if they were to select a forest homesite. Responses were classed into 11 categories, ranging from 0 percent (fire hazard would have no relative effect on preference) to 100 percent. As shown in table 3, between-S SB and Pre rating groups estimated fire hazard importance at just under 50 percent, while the subjects who had just rated 50 sites for FH gave a higher mean estimate of 60 percent. ANOVA confirmed a significant effect of rating scale, F(2/96) = 4.13, MSE = 4.54, and post hoc tests (Student-Newman-Keuls, SNK) revealed that the FH group gave significantly higher verbal importance estimates than SB and Pre, which did not differ. The within-S group verbal fire hazard importance estimates (45.6%) were not different from the between-S SB and Pre groups, but were lower than the FH rating group, as confirmed by ANOVA, F(3/135) = 3.05, MSE = 4.99, and SNK post hoc tests for the combined between- and within-S conditions.

Table 2.—*Standardized Regression Coefficients (β): Pre = f(FH, SB)*

	β FH	β SB	F(2/47)	R^2	AdjR^2
Between-S	-.553	.504	160.82	.873	.867
Within-S	-.294	.803	323.47	.932	.929

Table 3.—*Comparison of perceptual versus verbal estimates of fire hazard importance*

Group (real)	Verbal FH %	Perceptual FH %
Between-S SB	46.4	54.5
Between-S FH	*60.0*	
Between-S Pre	47.4	
Within-S	45.6	14.2

Perceptual FH % = $[\beta^2_{FH} / (\beta^2_{SB} + \beta^2_{FH})] 100$

A perceptual ratings-based fire hazard importance index was calculated from the standardized regression coefficients (β) for SB and FH ratings, as noted in table 3.[3] The perception-based index of the importance of fire hazard for the between-S groups was slightly higher than the verbal estimates for SB and Pre, and slightly lower for the FH group. In contrast, the perception-based index was substantially lower for the within-S condition, compared to the between-S perception index and to the within-S group's own verbal estimates of fire hazard importance. The correlation between verbal and (implied) perceptual fire hazard importance for individual subjects in the within-S condition (calculated separately for each subject) was positive, but weak (r = .34). However, a sizable minority of these subjects did show substantially higher consistency between verbal and perceptual expressions, as revealed in the scatter plot in figure 2. For the majority of subjects showing little or no relationship, the largest group expressed moderate to high verbal concern about fire hazard (40-100%), while showing little or no effect of fire hazard (0-20%) as assessed by their own perceptual ratings.

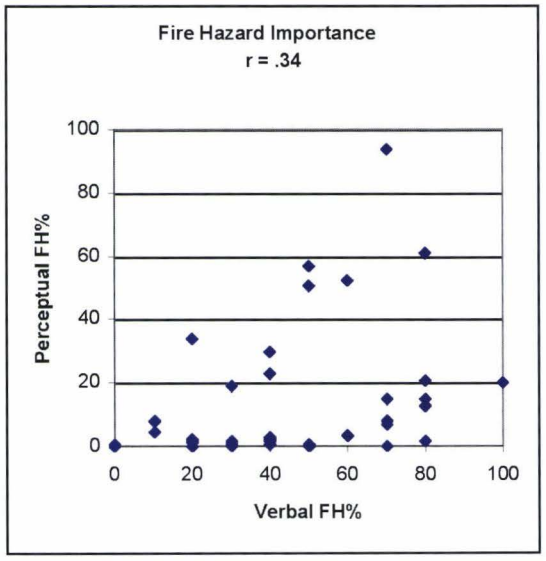

Figure 2.—*Scatter plot of individual subject (within-S condition) correlation between verbal and implied perceptual fire hazard importance estimates.*

[3] Several other options for measuring the "importance" of a single variable in a multiple regression equation are offered in statistics texts. Calculations based on partial and part correlations, recommended by some authors, were not substantially different from the reported index based on the squared β coefficients.

DISCUSSION

Previous research provides a substantial basis for expecting the observed high levels of internal consistency of ratings of scenic beauty and environmental preference. Moreover, decades of studies support the validity of assuming these ratings to be valid, both for actual forest sites, as opposed to photographic/digital representations, and for general publics, not restricted to college student subjects (e.g., Coughlin and Goldstein 1970, Daniel and Boster 1976, Daniel and Meitner 2001, Kellomaki and Savolainen 1984, Shuttleworth 1980, Stamps 1990, Zube 1974). This study adds that students, with little or no training or experience, produced consistent ratings of *fire hazard* for the hypothetical forest homesites represented. Mean hazard ratings showed only moderate positive correlations with hazard indices calculated by an appropriate fire behavior model. However, the fire model was designed to apply to areas larger than the hypothetical homesites (plots) studied here, so there is likely to be considerable error in the hazard indices produced. In addition, the restricted range of the distribution of model-based indices (only a few were over 1.00) limited the obtained correlations, very likely underestimating the validity of the fire hazard ratings. These results support the conclusion that students, and by implication other lay publics, can perceive and consistently and accurately assess the hazard represented by vegetative fuels.

Fire hazard ratings, both between and within subjects, showed reasonable and consistent (negative) relationships to both scenic beauty and overall preferences for forest homesites. Multiple regression analyses showed that homesite preferences were very well explained/predicted by the combination of fire hazard and scenic beauty. In tradeoff terms, overall preferences for the between-S groups were equally balanced between the positive contribution of scenic beauty and the negative contribution of fire hazard. For the within-S condition, the tradeoff showed a much weaker contribution of fire hazard, with scenic beauty accounting for a greater share of homesite preferences, even though the between- x within-S FH ratings showed the highest correlation of the three scales. Arguably, the within-S condition better represents the perceptual/judgmental task of actual wildland-urban interface residents, who must balance all concerns simultaneously. Overall, these results indicate that fire hazard, while accurately perceived, may not be the predominant,

or even a significant concern for residents of the wildland-urban interface. Consistent with a number of previous studies (e.g., Daniel and Ferguson 1991, Taylor and Daniel 1984, Winter and Fried 2000), forest homesite preferences are best represented as a tradeoff between fire safety and aesthetic/amenity values.

For all conditions in the experiment, verbal expressions of the importance of fire hazard generally indicated a 50-50 balance with aesthetic/scenic beauty values. The fire hazard-rating group (between-S) did show slightly elevated estimates, likely reflecting the effects of having focused exclusively on fire hazard in their preceding perceptual ratings. The perception-based indices derived from the ratings of the between-S conditions were equal to, or slightly higher than the verbal estimates of fire hazard importance. In contrast, the tradeoff implied by the perceptual ratings of the within-S condition showed fire hazard to have substantially lower weight than scenic beauty in their overall preferences. The majority of the within-S group verbally expressed moderate to high importance for fire hazard, but the preference ratings of most of these same subjects showed little or no effect of their own ratings of fire hazard. These subjects exhibited highly consistent and essentially accurate perceptions of the hazard represented by vegetative fuels and, in response to a verbal question, they indicated that fire hazard was as important as scenic beauty in selecting a forest homesite. Yet their own preference ratings indicated that fire hazard was much less important than scenic beauty, showing a discrepancy between words and actions that is not at all uncommon in psychological research (e.g., Cole and Daniel, in press; Corral-Verdugo 1997; Nisbett and Wilson 1977).

CONCLUSIONS

For wildfire risk managers, this study brings good news and bad news. The good news is that with very little education the public will very likely be able to consistently and accurately perceive the hazard represented by vegetative fuels. It also seems likely that people can easily be made aware and will readily acknowledge (verbally at least) that fire hazard/safety should be at least one important consideration for homesites in wildland-urban interface areas that are prone to wildfires. The bad news is that it is likely to be very difficult to get people to support single-minded hazard reduction treatments, such as large bare "fuel breaks" or any other options that do not adequately protect aesthetic values, especially if that support requires action and not just words.

This research also provides some hopeful signs that sustainable public support for fuel-reduction risk management strategies can be attained. For the ponderosa pine sites studied (and likely for many other forest types), there was a negative correlation between perceived scenic beauty and fire hazard—implying a positive correlation between scenic beauty and fire *safety*. While this relationship is certainly not perfect, it does suggest that there should be forest vegetation (fuel) conditions that can substantially reduce (but probably not eliminate) wildfire hazard and still retain relatively high levels of aesthetic/scenic values. The challenge is to design effective fuel reduction treatments that better reflect the safety-aesthetic value tradeoffs that wildland-urban interface residents desire and that they are more likely to actively support.

ACKNOWLEDGMENTS

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OBSERVANCE-INFLUENCE OF FIRE MANAGEMENT AND PLACE ATTACHMENT AT BIG SUR

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ABSTRACT.—Observance-influence analysis and place attachment are used in an exploratory study of wildland fire management in the Big Sur region of the central California coast. The on-site visitor survey examines fire management practices and occurrences that visitors observe and how these affect visit quality. Place attachment is separated into high and low levels to analyze grids based on overall attachment, and dimensions of place identity and place dependence. The results indicate that visitors do not have high observance or influence scores. Place attachment shows promise for a means of segmenting visitors.

The extreme fire season of 2000 brought significant attention to the impact of wildland fires on Federal lands and the loss of homes and structures due to these fires. In an effort to develop a comprehensive plan to manage the impacts of wildland fires on communities and the natural environment, an interagency National Fire Plan was established.

One purpose of the plan is to address complex fire management issues within the wildland-urban interface. The human dimension and social sciences provide a key foundation to assist agencies and communities in responding to wildland fires. There is a need to understand how wildland fires and fire management impact public lands as well as visitors to these lands.

Visitors to forests, parks, and open space areas may experience fire management strategies, restrictions, or suppression activities during their stay. If observed, these practices could impact the quality of a visit. Managers need to know which impacts visitors observe and which they perceive to most influence the quality of visits (Hammitt *et al.* 1996).

A marketing approach used in park and recreation management for nearly 20 years is importance-performance analysis. First introduced by Martilla and James (1977) in the marketing literature, it has proven a useful tool for determining what facilities, services, and programs are important to visitors and an agency's performance in providing these facilities, services, and programs. Typically, each of these attributes is placed on a grid, and the intersection of an attribute's importance and performance scores falls in one of four quadrants: concentrate here, keep up the good work, low priority, or possible overkill. A manager is able to use this as one of several points in making decisions regarding customer satisfaction and the performance level of an agency.

Hammitt *et al.* (1996) introduced observance-influence analysis as a variation of importance-performance analysis. Their approach examined the observance of park and resource impacts and the influence of these impacts on the quality of visitors' experiences. Similar to importance-performance, scores are placed on a grid for analysis and for assistance in managerial decisions. Visitors' observations and their perceptions of experiences seem particularly applicable to how fire management practices and occurrences are viewed.

The extent that fire management influences the quality of recreation could also depend on visitors' thoughts, feelings, attachment, beliefs, or attitudes toward a particular

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destination. Place attachment is one approach to understanding the emotional and symbolic significance of natural resources and helps social scientists to understand the values that individuals hold regarding these places (Warzecha and Lime 2001). Although definitions of place attachment or sense of place vary, one commonly accepted view is multidimensional, advocating concepts of place identity and place dependence. Place identity refers to the emotional and symbolic meanings (Moore and Graefe 1994, Proshansky *et al.* 1983) of places, spaces, resources, and settings. Place dependence is related to a setting's appropriateness for activities (Moore and Graefe 1994), comparison to other places, and functionality (Stokols and Shumaker 1981, Williams *et al.* 1995).

A destination that seems to hold a particular allure for many of its visitors is Big Sur along the central California coast. Located within the Los Padres National Forest, Big Sur is well known for its incredible ocean vistas, scenic beauty, coastal redwoods, and rugged terrain. The natural beauty of the area and the experiences it offers have the potential to create a sense of attachment to Big Sur as a special place for many of its visitors.

Due to its unique topography, varied climate, fuel conditions (Phippen 2001), and presence along a wildland-urban interface, Big Sur is an excellent location to study wildland fire management, observance of fire management, influence on visit quality, and place attachment to the area. In this exploratory study, we examined these variables to gain an initial understanding of how fire management impacts recreational activities in this locale.

METHODS

Study Area

For the purposes of this study, Big Sur was defined as the region along the California coast from approximately 55 miles north of San Luis Obispo to 19 miles south of Monterey. This route along Highway One is considered one of the most scenic drives in the United States. In addition to sightseeing, other year-round recreational activities that are popular in the region include picnicking, surfing, hiking, camping, wildlife viewing, backpacking, and beachcombing. During this first summer of data collection, the sites included in the study were USDA Forest Service day-use picnic areas, beaches, and overnight campgrounds.

Survey Instrument

The onsite survey used a 5-page questionnaire and included demographic items such as age, education, race/ethnicity, income, and principal residence. This analysis from a larger survey also examined an 11-item, 5-point Likert-type scale to measure place attachment dimensions of place identity and place dependence (Williams 2000) and an 11-item, 5-point observance-influence scale (Hammitt *et al.* 1996). Recreational activities and a primary recreation activity during the visit were also ascertained.

Study Procedures

Recreationists were contacted on 15 randomly selected days during July and August 2001 at seven randomly selected Forest Service picnic areas, campgrounds, and beach sites in the Big Sur region. Two sites were randomly selected for each day. Data were collected on weekdays and weekend days with a target of 66 percent weekend days selected based on use estimates by the Los Padres National Forest, Monterey District Recreation Manager. Normally, contacts with recreationists occurred between 9:30 a.m. and 5:00 p.m. Only individuals 18 years and older were included in the survey.

Individuals were asked onsite if they were willing to participate in the survey. Trained research assistants distributed the questionnaires and collected them upon completion. All subjects were informed of the anonymous nature of the survey and were assured that participation in the study was voluntary.

RESULTS

Questionnaires were completed by 498 Big Sur recreationists. Most individuals were male (52.5 percent), an average of 37 years old, married (52 percent), and from California (79.8 percent). Some visitors were from other U.S. states (13.9 percent) or different countries (6.3 percent). Respondents were mostly white (80 percent) with other frequent responses of Other Racial Category

(8.3 percent), American Indian/Alaskan Native (2.3 percent), Mexican (2.3 percent), and Asian (2.1 percent). Reported household income was above $55,000 for 54.5 percent of the subjects and above $75,000 for 38.3 percent. Many individuals (85 percent) had completed some college education with 29.9 percent studying at the graduate level.

Subjects also indicated characteristics related to their Big Sur visit. Visitors were usually camping overnight (77.8 percent) during their stay. Others were mostly day-use visitors (12.5 percent) or staying in accommodations such as a hotel or bed and breakfast (7.7 percent). Group composition was primarily family members (34.0 percent), family and friends (33.6 percent), or friends (26.1 percent). The average number of people in a group was 5.74 individuals. Groups usually stayed one night (18.2 percent), two nights (38.1 percent), or three nights (21.2 percent).

We were also interested in the visitors' activities, experiences, and recreational activities. First, the subjects were presented a list of potential recreational activities that they might have participated in during their trip to Big Sur and were asked to indicate all activities that applied to their current visit (see table 1). The most commonly selected activities were camping (75.5 percent), hiking (72.4 percent), walking for pleasure (70.7 percent), beachcombing (59 percent), picnicking (55.4 percent), wild/marine life viewing (54.8 percent), and sightseeing (52.5 percent). Next, the subjects indicated their one primary recreational activity. The most frequent responses were camping (35.7 percent), surfing (15.3 percent), and sightseeing (12.4 percent). See table 2 for a complete list of primary activities.

Table 1.—*Big Sur recreational activities*

Activity	Frequency	Percentage
Camping	372	75.5
Hiking	357	72.4
Walking for pleasure	348	70.7
Beachcombing	291	59.0
Picnicking	273	55.4
Wild/marine life viewing	270	54.8
Sightseeing	259	52.5
Photography	216	43.9
Exploring tidepools	203	41.2
Sunbathing	198	40.2
Swimming/wading	193	39.1
Driving for pleasure	176	35.7
Surfing	127	25.8
Eating at Big Sur restaurant	114	23.1
Taking dog for walk	90	18.3
Shopping in Big Sur region	90	18.3
Backpacking	60	12.2
Ocean fishing	49	9.9
Jogging/running	45	9.1
Other activities	37	7.5
Mountain biking	33	6.7
Scuba/snorkel	26	5.3
Kayaking	23	4.7
Naturalist-led activities	21	4.3
Road biking	14	2.8
Hunting	9	1.8
Horseback riding	8	1.6

Observance-Influence of Fire Management

The observance-influence scale was used to explore whether an understanding of visitors' perceptions of fire management could be gleaned from visitors' observations and how they felt these practices and occurrences might negatively influence the quality of their visits to Big Sur. The scale was a 5-point Likert type scale from 1—not at all observed—to 5—extremely often observed—to rate observance items. Influence was rated from 1—not at all an influence—to 5—very much an influence—on the quality of visit. Only responses from those subjects who completed both the observance and influence sides of the scale were used in the analysis. This resulted in a subsample of between 221 and 307 subjects (see table 3).

Overall, observance and influence mean scores were relatively low. The highest observance mean scores were 1.94, prohibition of fireworks in the forest; 1.78, observing evidence of a wildland fire; and 1.72, observing campfire rings next to a trail. Influence scores were highest on a restriction of no fires in pits/grills (2.28), large bonfires in the forest (2.26), and evidence of campfires in non-designated areas (2.11).

For the overall sample, 11 items were explored and placed on a grid for analysis (see fig. 1). The overall observance-influence grid provided few areas of managerial concern. Each score was plotted on the grid based on the intersecting point of the observance and influence mean scores. Crosshairs were positioned from overall mean scores of all observance and influence items. One score (restrictions of no fires in pits/grills) fell in the "concentrate here" quadrant, evidence of campfires in non-designated areas was directly on the crosshair between "concentrate here" and "potential concern," and large bonfires in the forest was located in the "potential concern" quadrant.

Table 2.—*Primary recreational activities*

Activity[a]	Frequency	Percentage
Camping	178	35.7
Surfing	76	15.3
Sightseeing	62	12.4
Hiking	39	7.8
Walking for pleasure	18	3.6
Beachcombing	22	4.4
Backpacking	11	2.2
Fishing	11	2.2
Relaxing	10	2.0
Driving for pleasure	8	1.6
Birding	6	1.2
Photography	5	1.0
Sunbathing	4	0.8
Wild/marine life viewing	4	0.8
Picnicking	3	0.6
Scuba/snorkel	3	0.6
Swimming/wading	2	0.4
Eating at a restaurant	2	0.4

[a] Includes only activities with two or more responses

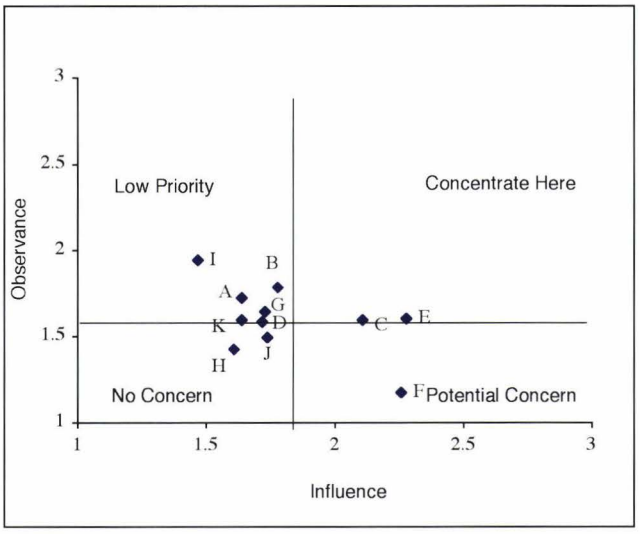

Figure 1.—*Overall observance-influence of fire management practices.*

Table 3.—*Overall observance-influence of fire management*

Practice/Occurrence		n	Observance mean	Influence mean
A[a]	Campfire rings next to trail	269	1.72	1.64
B	Evidence of wildland fire	307	1.78	1.78
C	Campfires in non-designated areas	293	1.59	2.11
D	Smoke prescribed fire	282	1.58	1.72
E	Restrictions no fires in pits/grills	289	1.60	2.28
F	Large bonfires in forest	256	1.17	2.26
G	No fire restrictions backpacking	221	1.64	1.73
H	Wildland fire suppression	246	1.42	1.61
I	Fireworks prohibition	259	1.94	1.47
J	Wildland fire smoke	282	1.49	1.74
K	Evidence of prescribed fire	289	1.59	1.64
	Overall means		1.59	1.82

[a]Letters A-K denote each practice/occurrence on figure 1.

Place Attachment and Observance-Influence

In this preliminary analysis, we also explored whether place attachment affected observance of fire management activities and the influence of these activities on visit quality. Place attachment was separated into high and low levels based on the median of all scores. Six place attachment items measured place identity and five items measured place dependence. Therefore, an additional six grids were produced: high and low place attachment, high and low place identity, and high and low place dependence. To extend the analysis beyond an observance-influence grid, independent sample t-tests were conducted to examine statistically significant differences between high and low attachment, identity, and dependence scores.

Placement attachment scores and their influence on observance-influence are presented in figures 2 and 3. The distribution of the scores is similar to the overall sample scores for observance-influence of fire management practices. In figure 2, the notable differences were restrictions of no fires in pits/grills that floated from "concentrate here" to a "potential concern," evidence of campfires in non-designated areas moving into "concentrate here," and no fire restrictions when backpacking changing from "low priority" to "concentrate here." Figure 3 differed little from the overall sample grid. The t-tests indicated significant differences between high and low place attachment observance scores for evidence of a wildland fire, campfires in non-designated areas, smoke from a prescribed fire, no fire restrictions when backpacking, wildland fire suppression activities by firefighters, prohibition of fireworks in the forest, and evidence of a prescribed fire. Influence attachment scores were significantly different for large bonfires in the forest and for no fire restrictions when backpacking (see table 4). For all of these fire management practices, the high attachment scores were higher than the low attachment scores.

Figures 4 and 5 present grids for high and low place identity observance-influence scores, respectively. Once again, scores differed little in their distributions on the grids except that in figure 4 evidence of a wildland fire was located in the "concentrate here" quadrant. T-tests

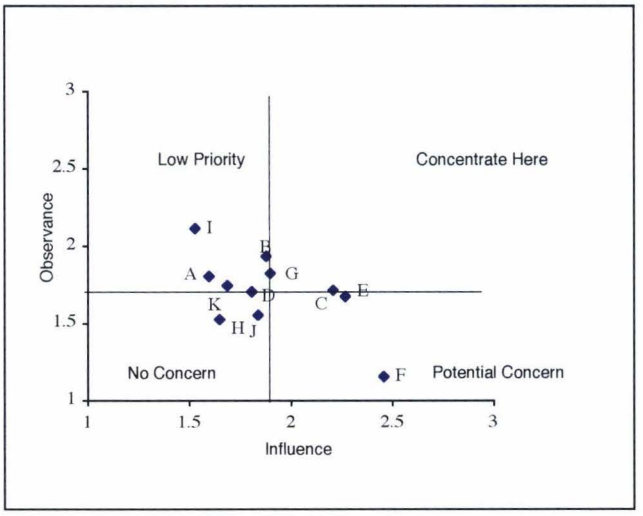

Figure 2.—*High attachment observance-influence of fire management practices.*

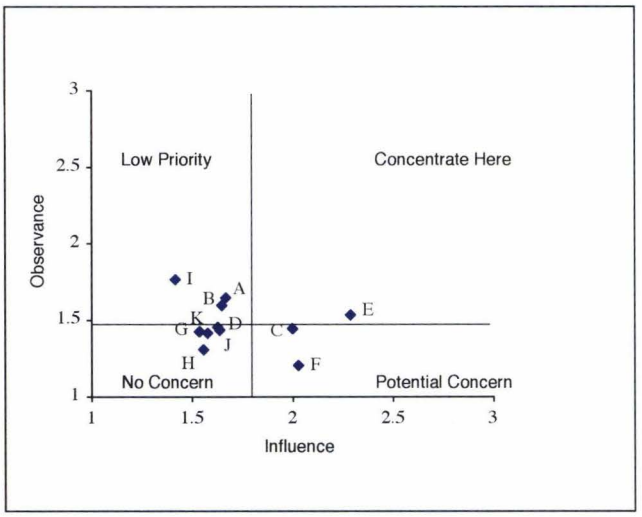

Figure 3.—*Low attachment observance-influence of fire management practices.*

were conducted to examine differences in high and low scores (see table 5). Statistically significant observance scores occurred for evidence of a wildland fire, campfires in non-designated areas, smoke from a prescribed fire, no fire restrictions when backpacking, wildland fire suppression activities by firefighters, prohibition of fireworks in the forest, visible wildland fire smoke, and evidence of a prescribed fire. Significant influence differences were present for evidence of a wildland fire and for large bonfires in the forest. Mean scores were again highest for high identity individuals on all of these fire management practices.

Table 4.—*Place attachment and observance-influence of fire management*

Practice/Occurrence		High attachment observance	Low attachment observance	Sign.	High attachment influence	Low attachment influence	Sign.
A[a]	Campfire rings next to trail	1.80	1.64	.154	1.60	1.67	.576
B	Evidence of wildland fire	1.93	1.59	.0001	1.88	1.65	.08
C	Campfires in non-designated areas	1.71	1.44	.003	2.21	2.00	.165
D	Smoke prescribed fire	1.70	1.45	.008	1.81	1.63	.161
E	Restrictions no fires in pits/grills	1.67	1.53	.120	2.27	2.29	.899
F	Large bonfires in forest	1.15	1.20	.395	2.46	2.03	.032
G	No fire restrictions backpacking	1.82	1.42	.001	1.90	1.54	.019
H	Wildland fire suppression	1.52	1.30	.006	1.65	1.56	.506
I	Fireworks prohibition	2.11	1.76	.050	1.53	1.42	.459
J	Wildland fire smoke	1.55	1.43	.105	1.84	1.64	.137
K	Evidence of prescribed fire	1.74	1.41	.001	1.69	1.58	.312
	Overall means	1.70	1.47		1.89	1.73	

[a]Letters A-K denote each practice/occurrence on figure 2 and figure 3.

A final grid analysis was examined for the place dependence dimension of place attachment. High and low dependence grids were created (see figs. 6 and 7). The grids differed a bit from other high and low grids. For a second time, evidence of a wildland fire moved into the "concentrate here" quadrant (fig. 6). In figure 7 campfire rings next to a trail was located directly on the influence crosshair. Campfires in non-designated areas and restrictions of no fires in pits/grills continued to hover between "potential concern" and "concentrate here." T-tests of observance scores were significantly different for high and low dependence for evidence of a wildland fire, campfires in non-designated areas, smoke from a prescribed fire, no fire restrictions when backpacking, wildland fire suppression activities by firefighters, and evidence of a prescribed fire (see table 6). Evidence of a wildland fire was the only variable influencing the quality of visit that was significantly different between High and Low place dependence.

DISCUSSION

The benefit of observance-influence to managerial decisions is that it allows for a determination of impacts that visitors are aware of or have observed and those impacts that most influence experiences (Hammitt *et al.* 1996). Initially, observance-influence as a scale for examining the impacts of fire management practices seems to have minimal utility in this analysis. The relatively low ratings of mean scores indicate that the subjects have not observed many of the practices. All observance scores are below "2" on the scale, falling somewhere between "not at all observed" to "sometimes" observed. Although influence scores are higher than observance scores for 10 of the 11 items measured, only three scores are above "slightly" an influence on the quality of visit. The other eight scores fall between "not at all" an influence to "slightly" an influence.

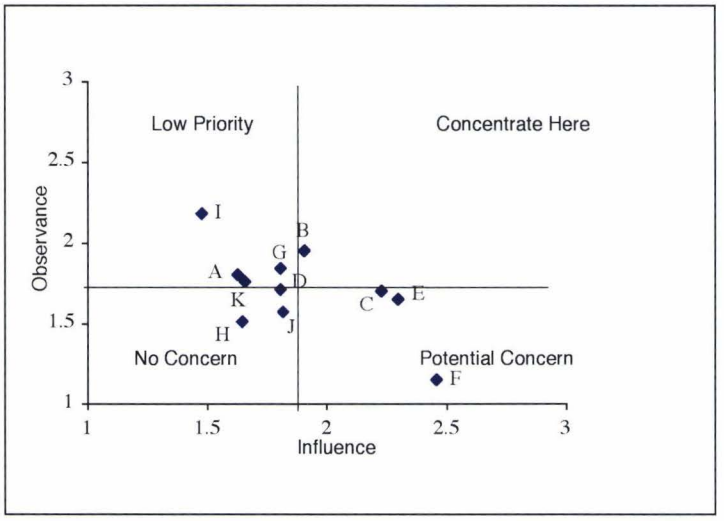

Figure 4.—*High Identity observance-influence of fire management practices.*

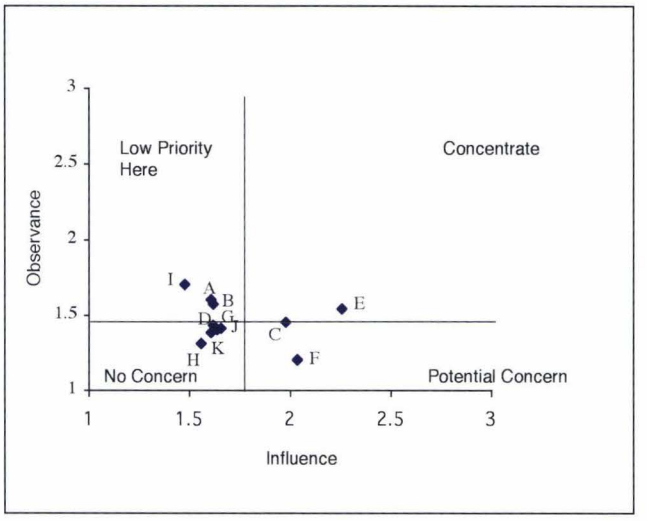

Figure 5.—*Low Identity observance-influence of fire management practices.*

Table 5.—*Place identity and observance-influence of fire management*

Practice/Occurrence	High identity observance	Low identity observance	Sign.	High identity influence	Low identity influence	Sign.
A[a] Campfire rings next to trail	1.80	1.60	.069	1.63	1.61	.891
B Evidence of wildland fire	1.95	1.57	.0001	1.91	1.62	.019
C Campfires in non-designated areas	1.70	1.45	.005	2.23	1.98	.092
D Smoke prescribed fire	1.71	1.43	.003	1.81	1.62	.137
E Restrictions no fires in pits/grills	1.65	1.54	.234	2.30	2.26	.803
F Large bonfires in forest	1.15	1.20	.464	2.46	2.04	.034
G No fire restrictions backpacking	1.84	1.40	.0001	1.81	1.64	.297
H Wildland fire suppression	1.51	1.31	.013	1.65	1.56	.491
I Fireworks prohibition	2.18	1.70	.006	1.48	1.48	.998
J Wildland fire smoke	1.57	1.41	.030	1.82	1.66	.223
K Evidence of prescribed fire	1.76	1.38	.0001	1.66	1.61	.646
Overall means	1.71	1.45		1.89	1.73	

[a] Letters A-K denote each practice/occurrence on figure 4 and figure 5.

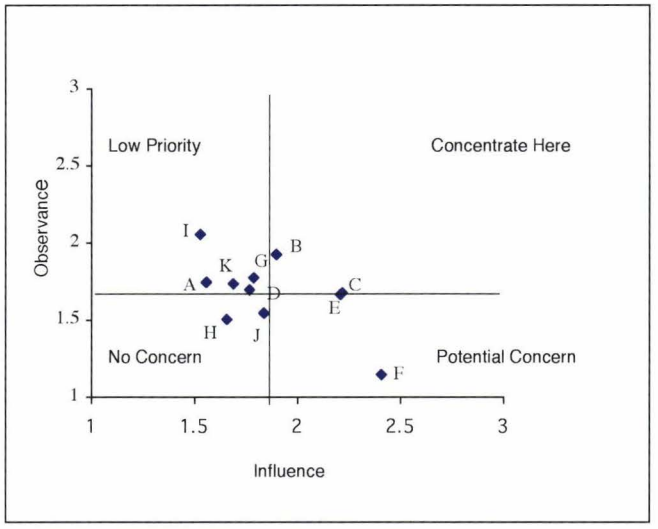

Figure 6.—*High dependence observance-influence of fire management practices.*

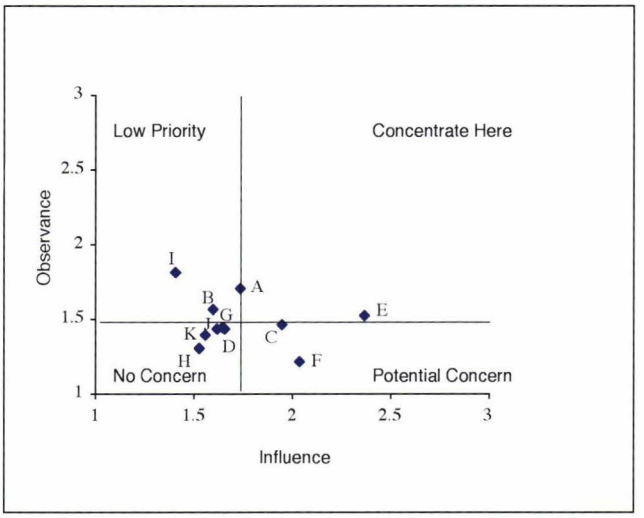

Figure 7.—*Low dependence observance-influence of fire management practices.*

Table 6.—*Place dependence and observance-influence of fire management*

Practice/Occurrence		High dependence observance	Low dependence observance	Sign.	High dependence influence	Low dependence influence	Sign.
A[a]	Campfire rings next to trail	1.74	1.70	.756	1.56	1.74	.193
B	Evidence of wildland fire	1.92	1.56	.0001	1.90	1.60	.021
C	Campfires in non-designated areas	1.67	1.46	.018	2.22	1.95	.062
D	Smoke prescribed fire	1.69	1.43	.004	1.77	1.66	.364
E	Restrictions no fires in pits/grills	1.66	1.52	.111	2.21	2.37	.387
F	Large bonfires in forest	1.14	1.21	.280	2.41	2.04	.062
G	No fire restrictions backpacking	1.77	1.44	.005	1.79	1.65	.360
H	Wildland fire suppression	1.50	1.30	.012	1.66	1.53	.344
I	Fireworks prohibition	2.05	1.81	.183	1.53	1.41	.439
J	Wildland fire smoke	1.54	1.43	.144	1.84	1.62	.107
K	Evidence of prescribed fire	1.73	1.39	.0001	1.69	1.56	.269
	Overall means	1.67	1.48		1.87	1.74	

[a] Letters A-K denote each practice/occurrence on figure 6 and figure 7.

An awareness of impacts on experiences that are not occurring is also important information for managers. For example, a previous study indicated that experience with wildland fires is related to perceived risks of fires (Machlis *et al.* 2002). Furthermore, knowledge regarding wildland fires can lead to increased support for management actions such as prescribed fires (Bright 1995). It may take specific strategies to reach individuals with little prior knowledge or experience.

Identifying specific audiences is essential in developing effective communication and education programs. These programs may attempt to influence behavior, increase knowledge and awareness, reduce risks, and provide support for decisions and policy formation (Machlis *et al.* 2002). Informational, educational, and interpretive programs can be tailored to a target market that may have little knowledge regarding wildland fire management. Development of these programs may increase awareness and observation levels of fire management practices in the Big Sur region.

The results from this study suggest that three fire management practices/occurrences are a concern for managers. Campfires in non-designated areas, restrictions of no fires in pits or grills, and large bonfires in the forest repeatedly fell in the "potential concern" or "concentrate here" quadrants. Interestingly, two of these three may be interpreted as the careless behavior of others. Previous research has found that acceptance of fires does not occur when the cause is careless actions (Taylor and Daniel 1984). It may be that observations of these situations has been heightened by the successful Smokey Bear campaign that often focuses on negligent or depreciative behavior. The third area of potential concern does address a management practice. Fire restrictions in developed campgrounds or picnic areas such as no fires in pits or grills directly influence experiences of recreationists. Many developed facilities include a pit or grill that is used for cooking or enjoying a campfire. The latter of these has been ingrained in the American camper as an expected experience and may be a difficult behavior or expectation to change.

Place attachment as a means of segmenting visitors shows some promise from the study's results. There are consistently significant differences in observance and influence mean scores based on high and low levels of place attachment and its dimensions of place identity and place dependence. Bricker and Kerstetter (2000) suggest that visitors may define and value natural resources differently based, in part, on place attachment. This may have implications for many variables beyond their study of place attachment and recreation specialization. For example, in the present study, the strong emotional ties that some visitors have with Big Sur apparently influence whether or not they observe fire management practices.

Attachment to a specific locale or environment is important for many managerial reasons. Recreation planners and managers need to take into account the opinions of individuals who feel a strong sense of attachment to a place in the planning process (Bricker and Kerstetter 2000) and should be concerned with public acceptance of fire management programs (Cortner *et al.* 1984). Furthermore, managers should consider various fire management actions and strategies, keeping in mind how these decisions will impact quality of experiences. Individuals who have bonds with a place similar to Big Sur can have a major role in how effective future planning processes, policy setting, and decisions are received by area locals and visitors. The public should be informed and educated about wildland fires because future policy will affect them (McCool and Stankey 1986) and they may, in turn, influence the formation and implementation of these policies (Taylor *et al.* 1986).

The results offer some implications for future research related to the influence of wildland fire management on recreational experiences. A more direct measure of previous experiences with wildland fire management while recreating at Big Sur seems necessary. Visitors could be asked directly whether they have been to a park or forest while a prescribed fire or wildland fire was happening. As an alternative, a study location with recent wildland fire evidence could result in a different outcome. Furthermore, although visit quality was measured as a negative experience, it is possible that visitors could view fire management practices and occurrences in a positive light. The same impacts may be viewed positively or negatively by different recreationists (Hammitt *et al.* 1996).

Place attachment's relationship to other variables collected during this first summer of data collection warrants attention. For example, recreational constraints due to fire management and recreational activities both have promise for market segmentation analysis. These variables are a

portion of the survey but have not yet been reported in detail.

Social science research related to wildland fire management will continue to help shape future planning and policy. Studying recreationists is one piece of this puzzle that may aid managers and researchers in their efforts to understand the human dimension, develop effective educational and informational programs, and recognize the importance of maintaining quality recreational experiences during fire management proactive, active, and reactive situations.

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PUBLIC PERCEPTIONS OF DEFENSIBLE SPACE AND LANDSCAPE VALUES IN MINNESOTA AND FLORIDA

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ABSTRACT.—Homeowners' preferences for vegetation near their homes and defensible space options are documented for wildfire prone areas in Florida and Minnesota through 80 indepth interviews and home site visits. The dominant preference for "natural" landscapes is articulated as valuing vegetated views, wildlife, recreation, quiet, solitude, and privacy. Homeowners recognize wildfire risk but vary in their perceptions of effective wildfire prevention measures and actions taken to reduce their risk. Most of these homeowners are supportive of prescribed burns, especially if fire experts who understand the local ecology and fire behavior conduct the burns.

Wildland fire across the United States has placed a number of residents at risk and stressed the resources of many forestry and fire agencies as they work to suppress the fires. To address the risk from wildland fire, there must be a mosaic of fuel treatments across multiple landowner types. Residents can play an important role in reducing their risk by creating defensible space around their homes and in supporting fuel treatments on nearby undeveloped private or public lands. These landowners will ultimately be responsible for fire preparedness.

Despite strongly worded messages from forestry and fire agencies, some residents are not very interested in or concerned about reducing vegetation around their home to reduce their risk. Messages to encourage residents to reduce fuels around their house often focus on the risk of fire to the exclusion of many other values homeowners seek in their rural, wooded residences. Their landscape preferences, attitudes about fire, and neighborhood regulations could affect their willingness to create defensible space, regardless of the information they receive. In addition, many interface residents may be at risk due to large tracts of undeveloped land near their homes, and their perceptions of the management activities on these surrounding lands may affect their willingness to alter their own landscapes. On one hand, a perceived lack of management may breed an attitude of "why bother." On the other hand, if homeowners are concerned about the use of prescribed fire in undeveloped areas, they may be more willing to create defensible space to protect their own property from possible runaway fires.

This article summarizes a recent study to identify and interview residents in two wildland-urban interface regions of the country: north central Florida and northeastern Minnesota. While the landscape and ecosystems are very different, both areas are at risk of wildland fire; both have a growing population; both have received messages from fire and forestry agencies about minimizing their risk of fire. We explored residents' landscape preferences, perceptions of wildfire, and willingness to accept fuel treatments on nearby undeveloped lands. This qualitative study focuses on 80 indepth interviews with homeowners, visiting their homes to see what they have done and to hear their explanations for how and why they manage their land. The value of this study is in better understanding the voices in the interface, exploring some

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of the attitudes that promote and prevent homeowner preparedness for fire, and revealing some potential strategies that may assist agencies as they work with residents of the wildland-urban interface.

METHODS

A random sample of homeowners at risk of wildland fire was conducted in northeastern Minnesota and north central Florida. Minnesota homeowners lived along the Gunflint Trail and the Caribou Trail in Cook County. The sample for these homeowners was stratified based on Gunflint seasonal, Gunflint permanent, Caribou seasonal, and Caribou permanent residents. Florida homeowners lived in six neighborhoods from Volusia, St. Johns, Marion, and Alachua Counties. These Florida residents owned properties valued from $30,000 to $300,000; Minnesota residents owned properties valued from $83,000 to $332,000. In both states, homeowners with more than one acre of land were identified by property tax roles, and where name, address, and phone numbers were available, were sent a letter inviting their participation in the study. A followup phone call was made to determine their interest and set up an appointment for an interview. Residents participated in the indepth interview at their home and completed a two-page survey.

Photographs of interface homes and modified landscapes were used to prompt participants to reveal what they liked about their landscape and why. Additional questions about neighborhood approval, perception of risk, experience with wildland fire, and tolerance of fuel treatments on nearby forested lands completed the interview.

A total of 80 interviews were completed. In Florida, 78 homeowners were randomly selected and contacted, and 43 interviews were completed, for a 55-percent completion rate. In Florida, the interview team felt they were getting new information with each interview, partially due to the diversity in their neighborhoods. In Minnesota, 46 homeowners were randomly selected and contacted, and 37 interviews were completed, for an 80-percent completion rate. The Minnesota interview team began to hear the same information by the 27th interview but continued with 10 more interviews to confirm the main findings.

HOMEOWNER DEMOGRAPHICS

The two samples were similar in that 70 percent (Florida) and 78 percent (Minnesota) of the participants owned 1 to 5 acres at risk of wildland fire. All of the Florida homeowners were permanent residents, and by research design, half the Minnesota homeowners were permanent residents. Half the Floridians had lived in their current homes for 3 to 10 years, and half the Minnesotans had lived in their current homes for more than 10 years. Most participants lived in their respective states, however, for more than 10 years. In both states, the homeowners represented a range of incomes. More Minnesota participants were retired (50 percent compared to 21 percent of Floridians) and had a college degree (71 percent in Minnesota and 44 percent in Florida).

RESULTS

Landscape Uses and Values

The Minnesota and Florida homeowners in this study have several important similar values for their landscape that influence their decisions about defensible space. They appreciate the natural appearance of the nearby woods, the view out their windows, and the recreational opportunities available on their land. They value privacy and seclusion, and they enjoy not only seeing nearby wildlife but also knowing that they are providing wildlife habitat on their property. Overall, homeowners in both states prefer a natural appearance to their landscape, but the local ecosystem and the residents' uses influence what constitutes "natural."

I clear a dead tree if it falls in the driveway. Otherwise, I leave it wild... dead trees are a part of the forest. (Minnesota)

Natural is my ideal look, trees for shade and attracting wildlife. (Florida)

What they call natural and what types of activities they enjoy, however, are more varied in Florida than in Minnesota. About one-fourth of the Florida residents spoke of the importance of open space around their home for crime prevention, gardening, and pets. While they

might have known that this space also protects them from wildfire, fire was not their main reason for creating and maintaining these openings. Others prefer to maintain the natural ecosystem.

I like the cleared look and the expanse of a grass lawn. (Florida)

I see grass and I wonder what (native species) was taken away. (Florida)

Lawns don't belong around here. It doesn't blend in with the surroundings. (Minnesota)

These natural landscapes have many qualities, including the aesthetically appealing viewscapes that homeowners can enjoy as they move around their land or sit at their kitchen table.

I like to enjoy the beauty of the trees and watch them grow. (Minnesota)

Actually, it would be nice to be outside but of course with the heat and everything, the mosquitoes, you tend to be inside so seeing green from every window is really important to us. (Florida)

Gazing out the windows is a main form of entertainment. (Minnesota)

Central to the concept of a natural landscape is the ability to watch wildlife and provide for wildlife habitat, a quality mentioned by Minnesotans (70 percent) and Floridians (53 percent). The verbs these homeowners used to describe their relationship with wildlife emphasize this value with more than a causal mention; they say "I love…", "I care…", "I take care…", or "I keep track…" of wildlife.

I feed the birds and enjoy watching wildlife. I love the forest and I love nature, and there are more animals and wildlife with trees. (Minnesota)

I love the birds and animals. I keep track of bird migrations. (Minnesota)

I like native vegetation too because it attracts birds and other wildlife, a major part of the attraction of living where we do. (Florida)

We like having a lot of wildlife…we've seen deer, rabbits, snakes, armadillos. We get a lot of things city people won't get. (Florida)

In addition, homeowners live in these natural landscapes because they provide an environment of quiet and solitude for the individual as well as create privacy and seclusion. Homeowners in both states referred to the vegetative attributes of the land providing "quiet" and "peace" that was valued as "healthy" and "right" for a person. One Minnesotan was most aware of these qualities once they were lost to her,

The land provides a sound buffer. Since the blowdown, you can hear what's being said at the neighbors' houses. (Minnesota)

As much as vegetation on the landscape provides a sound barrier, more homeowners emphasized the sense of seclusion trees can provide. Some define their private space as being shielded from neighbors with vegetation; others find privacy in being off the road or away from any nearby neighbors. Trees in the landscape gave these homeowners a sense that they were alone, unobserved by others. Many mentioned that privacy was central to the value of their homes as compared to the previous homes they owned in other towns, the suburbs, or the city.

It is a place to come and hide. (Minnesota)

I have two acres in woods between me and my neighbor, so I don't see him. It is bad to see neighbors. (Florida)

Finally, reflecting on their use of the surrounding landscape, homeowners in Florida and Minnesota mentioned similar recreational activities—entertaining outdoors, hiking/walking, ATV-ing, gardening, and relaxing. The ecosystem, climate, and public lands available for homeowner use best explain the differences in recreational uses between the two states. Most of the Minnesota homes are surrounded by national forest or wilderness areas; therefore, residents use their land and the public lands for snowshoeing, skiing, berry picking, and hunting. In Florida, homeowners build pools, firing ranges, trails, horseshoe pits, and soccer fields to further enjoy their land.

Perceptions of Fire Risk

When evaluating wildfire preparedness, homeowners base their decisions on their landscape values, but, what they decide to do is strongly influenced by their perception of the fire risk. The majority of homeowners in Florida and Minnesota (84 percent) believed the surrounding area was at risk for wildfire and slightly fewer believed their homes were at risk (Minnesota 68 percent). Overall, the homeowners believed they were at risk.

In both states, homeowners consider a variety of factors as they assess their risk for wildfire. Environmental factors, such as fire behavior, forest ecosystem, and climate, are used by participants to evaluate the contribution to risk that they can't do much about.

With the lay of the land and the lake, there's less risk because of the prevailing winds. (Minnesota)

It depends on what kind of fire came through. If you had a big fire like they have out west right now, embers can land on the house, even if there are no trees around. (Minnesota)

It's a problem here, but not a huge problem here because we're so surrounded by hardwoods. (Minnesota)

Pine trees topple too easily in hurricane winds, and they burn quickly. That's why we've cleared pines from near the house. (Florida)

The majority of the homeowners in both states used past personal experiences or recent personal fire prevention actions to explain their risk assessment. And a few homeowners pointed to the activities of others or the home's location in relation to major infrastructure as important factors that influence their personal risk.

In 1976 we were evacuated due to wildfire. We were close to being wiped out. Then the wind changed. (Minnesota)

I used to be concerned about my home, but I'm not too concerned now because I've installed an outdoor sprinkler and cleaned up most of the debris from the storm. (Minnesota)

I remember the thick, black, choking smoke for months during the summer. (Florida)

A police officer stopped by and told us to be ready to evacuate. It was scary to see embers falling on rooftops. Luckily the wind changed. (Florida)

Or

And there's a lot of campers going out. I know they require them to watch a video, but that doesn't mean they won't start a fire. (Minnesota)

Any home up here is a risk to a certain degree, and we are so far from the fire department. (Minnesota)

Overall, homeowners in this study have a complex set of factors that influence their assessment of personal risk and combine with their landscape preferences to influence their actions. In Florida and Minnesota, it is not a question of risk denial or ignorance about fire risk; the homeowners in this study recognize the risk of wildfire.

Perception of the Effectiveness of Home Protection Measures

When the Florida and Minnesota homeowners evaluate their relative risk of wildfire, they can consider a variety of wildfire protection measures. How effective they believe these measures will be at reducing their risk of wildfire is one influence on their willingness to take action (table 1). In Florida, more than 50 percent of the homeowners felt that most of the suggested options were effective or highly effective in reducing their wildfire risk. They had the greatest confidence in fire retardant building materials to save a structure when a fire does come through, and in insurance to replace a structure when the fire cannot be suppressed.

In Minnesota, the vast majority of the homeowners—seasonal and permanent alike—believed the most effective measures would be fire retardant building materials to prevent small fire ignitions, a good access road to save lives when the fire comes near, and good insurance to replace their home if it was destroyed by fire. A few along the Gunflint Trail believed in the effectiveness of sprinkler systems.

More than half of the homeowners in both states believed clearing vegetation near the house can be an effective or

Table 1.—*Wildfire protection measures perceived as effective or highly effective by Florida and Minnesota homeowners, 2002*

Wildfire protection measures	Florida N=43	Minnesota N=37
	Percent	*Percent*
• Fire insurance	77	94
• Fire retardant building materials	82	68
• Foam	58	35
• Sprinkler systems	37	49
• Width of access road	65	65
• Clearing vegetation near the home	65	54
• Clearing vegetation in undeveloped land	51	38

highly effective wildfire protection measure. However, many thought that clearing vegetation is only effective under certain circumstances depending on fire intensity, ecosystem type, and climatic conditions.

Actions Taken to Prevent Wildfire Damage

Documenting homeowner behaviors in fire protection is another lens that can provide insight into their evaluations of their risk, the options for wildfire protection, and their preferred landscape management.

We've reduced our risk by clearing most of the forest and putting in gardens. We installed an irrigation system and have a pump at the pond and a generator, but that's primarily for the gardens, not for fire. (Florida)

My home is not really at risk because I have cleared at least 125 feet around the house. There isn't much more I could do. (Florida)

I've taken out all the dead trees from the spruce budworm and cleared all trees down by the blowdown. I keep the immediate area around the house cleared of debris. Nothing is stored under the deck, no wood up against the house. (Minnesota)

We invested in a sprinkler system, and had nearby dead trees taken out due to fire danger. (Minnesota)

In Florida and Minnesota, homeowners have emphasized two fire prevention actions for their homes—reducing vegetation around the house and installing water sources (table 2). In both states, the majority of homeowners reported that they have reduced vegetation around their

Table 2.—*Homeowner actions taken for wildfire protection in Florida and Minnesota, 2002*

Wildfire protection actions	Florida N=43	Minnesota N=36
	Percent	*Percent*
• Invested in fire retardant building materials	28	22
• Installed chimney spark arrester	21	31
• Installed a water source	47	53
• Invested in a sprinkler system	12	33
• Widened the road leading to the house	33	25
• Reduced vegetation near the home	70	69
• Reduced vegetation far from the house	38	39

homes and to a lesser extent far from their homes. In 1999, straight-line winds in northern Minnesota flattened the forest on large tracts of land along the Gunflint Trail, increasing wildfire awareness. Many homeowners have actively cleared downed trees and brush from around their houses to clean up the area and reduce their risk of potential wildfire (69 percent). In north central Florida, where major wildland fires have occurred annually for several years, some homeowners have been very active in reducing vegetation around their homes (70 percent).

Approximately half of the respondents in both states have a water source for firefighting in case their houses are threatened. In Florida, one neighborhood was full of ponds, the result of fill removed to make the roads. Several homeowners recognized that these ponds were a source of water for fire suppression. In neighborhoods where landscaping is important, most homes have irrigation systems that can be used to keep groundcover wet. In Minnesota, several homeowners along the Gunflint Trail have installed sprinkler systems because a local business is promoting their use and lake water is readily available.

Homeowners reported other wildfire prevention actions, but less than a third of the homeowners have widened their driveways, installed chimney spark arresters, or invested in fire retardant building materials. On one hand, this may not impact their preparedness, since Florida homeowners may not have chimneys or new homeowners already have wide driveways built to acceptable zoning widths. On the other hand, many Minnesota homes are tucked away at the end of narrow "paths" that would not be accessible for fire equipment. In addition, fire retardant materials do not appear to be a priority for homeowners in either state.

Perceptions About Fuel Treatments

In the mosaic of forest land, a homeowner's fire risk will be greatly influenced by their neighbors' actions. In the patchwork of public and private land ownership, public agencies have developed a range of fuel treatments that have the potential to reduce an area's risk of catastrophic wildfire. General public opinion and closest neighbor opinions about different fuel treatments can influence an agency's ability to use prescribed burns, forest thinning, and herbicide applications. Homeowners that have property abutting public lands can have strong opinions about what should be done on adjacent public land. There was substantial support in Minnesota and Florida for prescribed burning on nearby undeveloped lands (68 percent and 40 percent, respectively). Other homeowners were careful to qualify their support contingent upon their perception as to whether managers are responsible, careful, and knowledgeable about the area's weather, fire behavior, and native vegetation (Minnesota 20 percent and Florida 45 percent). If the support and qualified support are taken together, more homeowners were more supportive of prescribed fire than the other treatments.

It was real spooky to see choppers dropping fire on the land. I know they burn responsibly, and that the fire didn't get out of control. I was impressed with their vigor, but I'm afraid of it too. There's always something that can go wrong, but it is a necessary evil. From a biological perspective, it is necessary. (Florida)

When they first told us about doing a prescribed fire, we didn't want it because we were afraid that they wouldn't do this correctly. But then we saw what happened in Flagler County. After that we said, 'Gee we really need to have this done,' I still feel that if the state did more controlled burns throughout the state it would be a safer place. They know what to burn and they know what to do and I think the controlled burns would definitely help a lot. (Florida)

I think they do a good job of planning when they're going to do it. In the 32 years of coming up here, I've never heard of a controlled burn that got out of control. (Minnesota)

I'm not worried about prescribed burns at all, despite Los Alamos or whatever. They've shown they can do them well. I have faith it can be controlled. (Minnesota)

In addition, most participants in both states were supportive of thinning on private and public undeveloped lands (Minnesota 68 percent, Florida 57 percent). In Minnesota, some residents made the qualification that thinning would be inappropriate in wilderness areas but acceptable on other public lands. In Florida, some believed it would be a good solution, others believed it would not be practical, and still others were not interested in what they believe would be a clearcut.

If that is what makes the most sense, I don't have a problem. (Minnesota)

Thinning is okay as long as the nature of the area is not destroyed. Clearcuts are not good but there is a compromise between clearcutting and doing nothing. (Florida)

It would be impossible to thin enough vegetation to reduce the risk of fire. You might as well make big firebreaks. (Florida)

There was very little support from participants in Florida's interface for herbicide treatments in nearby undeveloped lands (57 percent), and the perceptions were so strongly held that it may detract support from prescribed fire and basic risk reduction methods if managers launch an education campaign in favor of herbicide. Water contamination, defoliation, bioaccumulation, and insect population reduction were concerns. (Minnesotans were not asked about this option.) Overall, the majority of homeowners in both states supported prescribed burns and thinning when done by experts that know the local conditions.

Finally, when asked if their own use of defensible space around their homes would increase their support for prescribed burns on public lands, the resounding answer was NO. Most people supported well-executed prescribed burns regardless of the density of vegetation near their homes. Those who did not support prescribed burns felt that no amount of defensible space would make them feel safer or, in other cases, believed that prescribed burns are not effective ecosystem management options.

CONCLUDING REMARKS

The challenge for the future is to better understand how managers in the landscape can talk to homeowners across differing values and understandings about the best actions to take for wildfire preparedness. Homeowners choices to reduce their risk of wildland fire by using defensible space and other fire prevention measures are influenced by many factors. Some very knowledgeable people understand the risk of wildland fire and purposefully decide not to alter their landscape to reduce their risk. They may have a fatalistic attitude about "God's will" or they may value dense vegetation so much that they do not want to change it on the off chance that they may have a fire.

Some of these attitudes are so strongly held, it is doubtful that they will change. But other homeowners may be more likely to rev up the chain saw if the threat of wildfire is imminent, but only as a last ditch effort to reduce their risk.

It is a tradeoff; you have to balance the pros and the cons. I guess if we had another '98 fire, I would be pretty aggressive with the chain saw. But it could still happen, lightning could strike, in fact, that happened right around the corner from us. It burned part of the yard, but the fire department was there within 7 minutes. (Florida)

I think in a natural environment like this, fire's going to occur, and there's not a heck of a lot you can do about it. There are obvious things you do, but in terms of how much is the right amount, that's pretty hard to determine. I don't think we'd live here if we had to clear the whole forest. (Minnesota)

Fire and natural resource managers can use these perspectives to refine their messages to interface residents about reducing their wildfire risk. In some cases, reinforcing appropriate vegetation reduction messages for non-fire values could be useful: "reduce crime—get rid of bushes under your eaves" or "don't call a roofer, call a tree surgeon! Don't let a hurricane knock those trees on your house." For those who are not likely to prefer an open, reduced risk landscape, it is more important to reinforce their values for wildlife, privacy, and special vegetation along with reducing risk: "Quail need open habitat" or "Put these plants in your garden to attract butterflies and provide hours of enjoyment." Demonstration areas, photographs in popular magazines, and work with neighborhood groups may be helpful to introduce an acceptable vision of defensible space and develop a norm of regular maintenance. Managers should also accept that some residents would rather collect the insurance and rebuild elsewhere than alter their immediate landscape.

The diverse perceptions among the residents of Florida and Minnesota about the landscape and their risk of wildland fire ensure that communicating with and among residents will not be straightforward and simple. The similarities of perceptions between the two states, however, indicate that regardless of ecosystem and lifestyle, residents of the interface are there because they value nature, wildlife, and privacy. Those who wish to

communicate successfully should take the time to get to know the people who live at risk of wildland fire and understand the values they hold for their landscape and their perceptions of effective fire protection measures. By understanding what homeowners might be willing to change, managers will be more likely to craft a message that resonates with residents. Meaningful messages are more likely to be heeded.

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SEASONAL AND PERMANENT HOME OWNERS' PAST EXPERIENCES AND APPROVAL OF FUELS REDUCTION

Christine Vogt[1]

ABSTRACT.—This paper reports a study of seasonal and permanent homeowners in three wildland-urban interfaces in the United States: San Bernardino County in California, southwestern Colorado, and the panhandle of Florida. Past experiences with fuel reduction techniques, wildland fire, and fire education, as well as attitude toward and approval of prescribed burning, mechanical fuel reduction, and defensible space were evaluated. While many similarities were found, distinct differences between seasonal and permanent homeowners were identified. Geographic differences between states and homeowner types point to the importance of tailoring fire education efforts to the audience.

Increased wildland fires are creating threats to homeowners who live in wildland-urban interface areas. Land management and fire agencies at all government levels are called in to protect homes located adjacent to and in wildlands (Cohen 2000). According to Cohen (2000), loss of home to wildfire depends on the home ignitability and the fuels in the immediate home site and in the nearby community. Davis (1990) found that many parties need to share responsibility for decreasing fire loss in the wildland-urban interface, including homeowners, government agencies, construction companies, and the insurance industry. Davis (1990) reported that public dialogue, particularly involving policy leaders who make local zoning and infrastructure decisions, is absolutely necessary to begin addressing the risks of building homes near wildlands. Communications serve to educate homeowners on fire protection practices, also known as defensible space, and to influence public support for larger scale community and wildlands fire protection programs such as prescribed burning and mechanical fuel reduction.

Communicating and working with homeowners can be a challenge because homeowners have different levels of investment and commitment to their homes, property, and community. Wildland-urban interface areas have always been popular places for cabins or seasonal homes where homeowners may visit the area only once a year and their time at the home is intended to be vacation-like (i.e., relaxing, recreation activities). Cutting trees and removing brush and other flammable vegetation may conflict with the homeowners' intended vacation activities. Williams and Stewart (1998) suggested that seasonal homeowners may view the setting of a home and the nearby areas differently from long-time or permanent residents, which may affect seasonal homeowners' perceptions of wildfire risks and fuel reduction efforts. Property purchased for seasonal home use may eventually become a permanent home upon retirement (Godbey and Bevins 1987). A long-term commitment by a homeowner to a home and area that once served as a vacation place may perhaps result in different fire protection commit-ments by the homeowner. Green and his co-authors (1996) in a study of homeowners in Forest County, Wisconsin (near Michigan's Upper Peninsula), a county with an economic base in forest products and seasonal home ownership, found that permanent and seasonal homeowners differed greatly. Seasonal homeowners who made occasional visits were generally supportive of land use controls; however, as they spent more time in the area, they became more interested in county-wide issues, including even more rigorous land use controls. Perman-ent homeowners who were more dependent on the local economy for jobs and other municipal services were more supportive of local economic development and less supportive of land use planning.

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Given the growing difficulty of protecting homes and lives in wildland-urban interface areas, together with the mix of permanent and seasonal homeowners whose views on land use and fire protection approaches may differ, this study examined permanent and seasonal homeowners living in wildland-urban interface areas. Their levels of past experience with fuel reduction techniques, wildland fire and its effects, fire education and fire prevention or firefighting work; and attitudes held toward and support of prescribed burning, mechanical fuel reduction, and defensible space were assessed in this study (see Vogt, Winter, and Fried paper, this volume, for definitions of each).

METHOD

Site Selection

Five national forests were selected to represent wildland-urban interface areas where both permanent and seasonal homeowners could be found. Initially the national registry of communities at risk (USDA State and Private Forestry) was reviewed to begin the process of identifying study areas. The forests selected were diverse, representing geographic areas that reflected different vegetation, fuel loads, fire management, and culture and sociodemographics of homeowners. The intent was to select areas near communities with significant owners of both permanent and seasonal residences rather than extreme wilderness areas with low levels of home residency. The selected study areas were San Bernardino National Forest, California; Grand Mesa, Uncompahgre, and Gunnison (GMUG) National Forests/Bureau of Land Management, Colorado; and Apalachicola National Forest, Florida. The California study site, located near Los Angeles, includes the communities of Arrowhead and Big Bear Lake, located in San Bernardino County. The Colorado study site was located between Durango and Grand Junction in southwest Colorado, specifically Ouray, Montrose, and Delta Counties. The Florida study site was located west of Tallahassee in the panhandle area of the state and includes Leon, Liberty, and Wakulla Counties. The three national forests in Colorado, which are jointly managed by the Forest Service and Bureau of Land Management, were treated as a single study site. After study sites were selected, visits were made to the areas to learn more about home ownership, fuel management programs, and past wildland fire effects. During each study site visit, a focus group was held with fire staff (including the regional fire manager and a Firewise educator). In California, local fire department chiefs, and in Colorado, representatives from the Red Cross who manage a fuel management education program, also attended the focus group meetings. Efforts were also made to hold focus groups with homeowners. In California, a focus group was held with nearby residents, many of whom had purchased homes for seasonal or vacation use and now lived in the area full-time. In Colorado, interviews were conducted with several homeowners who, encouraged and assisted by the Red Cross, built their homes with defensible space. Also during study site visits, residential interface areas were visited, selected, and enumerated by county, township, section, and range specifications that were then presented to county tax assessors to obtain lists of homeowner names and addresses. In California, two areas were selected: Running Springs (a community west of Big Bear Lake) and Sugarloaf (a large neighborhood east of Big Bear Lake). In Colorado and Florida, numerous residential areas were selected in the three counties but did not encompass any one entire community.

Study Site Descriptions

The vegetative land cover in the areas studied on the San Bernardino National Forest is primarily white fir and Jeffrey and lodgepole pine. The area has had wildfires that have caused evacuations and road closures. Prescribed burning occurs on a very limited basis. The vegetative land cover in the GMUG National Forests is primarily pinyon and juniper pine. Mechanical fuel reduction is regularly practiced, particularly in newer subdivisions and within Forest Service special use permit cabin areas (fig. 1). The number of housing units in the Colorado counties studied (based on 2000 Census data) ranges from 1,576 in Ouray County, 11,058 in Delta County, and 13,043 in Montrose County. The vegetative land cover in Apalachicola National Forest is primarily slash and longleaf pine. Prescribed burning is regularly practiced with several hundreds of thousand acres burned annually (fig. 2), and fuels quickly grow back only months after a burn (fig. 3). The number of housing units in the Florida counties studied ranged from 2,222 in Liberty County, 8,450 in Wakulla County, and 96,521 in Leon County where Tallahassee is located.

Figure 1.—*Mechanical fuel reduction program in a special use permit cabin area, Delta County, Colorado.*

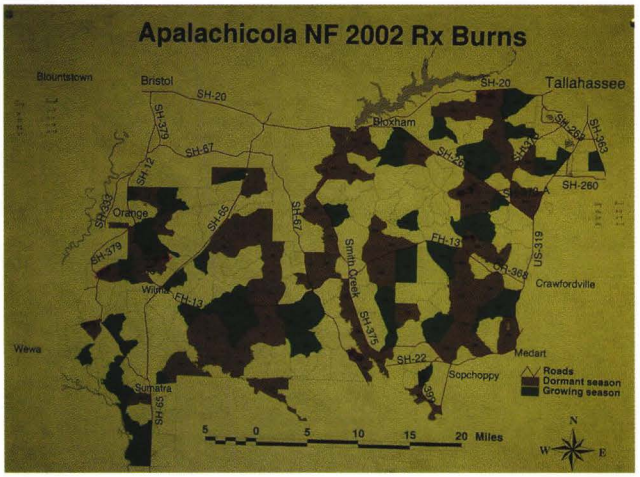

Figure 2.—*Prescribed burn schedule by Apalachicola National Forest in Leon, Liberty, and Wakulla counties, Florida.*

Figure 3.—*Examining fuel regeneration in Apalachicola National Forest, Florida.*

Data Collection Procedures

Data collection occurred in fall 2001, overlapping the events of September 11, 2001, and the anthrax scare. A modified Dillman (1978) survey method was used where each household received a personalized letter, a prepaid business reply envelope, and a pre-numbered questionnaire. Questionnaires were mailed to the address a tax bill would be mailed to, which meant that seasonal homeowners most likely received their questionnaires at their permanent homes. The letter included an incentive whereby 1 out of 250 households could be selected for a $25 gift certificate to either Wal-Mart or Lowe's. A reminder or thank you postcard was mailed approximately 1 week after the first mailing. After 3 weeks, those households that had not responded were mailed another questionnaire. At the time of first and second questionnaire mailings, press releases to local newspapers were mailed with followup phone calls to the editor to increase awareness of the study, particularly with permanent homeowners.

Response rates ranged from 21 to 47 percent (table 1) with a composite response rate of 38 percent. In total, 2,781 homeowners were sampled and 281 bad addresses were identified, for an effective sample size of 2,500. Across the three study sites, 939 surveys were completed and returned. In all three study sites, permanent homeowners responded at a higher rate than seasonal homeowners, which could be explained by the press releases in local papers or possibly greater interest in fire by permanent residents. Bad addresses were the highest in California even though the tax records had just been updated; however, San Bernardino was the largest county with a population of 1.7 million and a half of a million households. Nonresponse bias was checked by comparing demographic characteristics of permanent homeowners to the available census data (1990). In all three study areas, the respondents tended to be better educated, reported higher levels of income, and were more likely to be male in comparison to the general population.

Table 1.—*Response rates*

Study sites	Type of residency	Original sample size	Bad addresses	Effective sample size	Respondents	Response rate
		- - - - - *Frequency* - - - - -				*Percent*
California	Permanent	362	74	288	119	41
	Seasonal	638	117	521	176	34
Colorado	Permanent	566	20	546	254	47
	Seasonal	215	14	201	66	33
Florida	Permanent	711	33	678	267	39
	Seasonal	289	23	266	57	21
Total		2,781	281	2,500	939	38

Measurement and Data Analysis

Data were collected using a mail questionnaire to homeowners. Permanent and seasonal homeowners were first classified based on mailing address provided by the tax assessor's office or any other information that suggested permanent home ownership (i.e., homestead exemption). The permanent and seasonal samples were proportionate to the population of the selected study areas. In the questionnaire, respondents were asked to provide their length of residency (i.e., permanent was labeled as residing year-round; seasonal was labeled as residing at certain seasons/time periods or vacation/weekend use). The questionnaire used was very similar to the instrument used by Vogt, Winter, and Fried (this volume). An eight-page questionnaire contained questions about (1) experiences homeowners have had with fuel management approaches, wildland fire, and fire education; (2) attitudes toward fuel management approaches including prescribed burning, mechanical fuel reduction, and defensible space; (3) support for each of the fuel management approaches; and (4) sociodemographics. Experience questions were asked as "check all that apply" over a lifetime. The attitude and approval questions were asked in regards to the fuel reductions occurring near their homes. A seven-point Likert scale was used where "-3" represented extremely negative (disapprove), "0" represented a neutral position, and "3" represented extremely positive (approve).

Descriptive statistics were calculated to examine similarities and differences across the three study sites as well as between permanent and seasonal homeowners. On experience items, Chi-square tests were used to identify strong associations between an experience and the two homeowner groups (permanent and seasonal) in a single study site. On attitude and approval items, t-tests were used to identify significant differences in the mean scores for each homeowner group in a single study site. On all statistical tests, a $p<.05$ was used to identify meaningful differences between permanent and seasonal homeowners.

FINDINGS

Description of Respondents

California respondents were more likely to be male than female, hold high levels of education (84 percent of permanent homeowners and 79 percent of seasonal homeowners had attended or graduated from college or graduate school), and be employed full- or part-time (42 percent of the permanent and 45 percent of the seasonal homeowners) or retired (42 percent of permanent and 43 percent of seasonal homeowners) (table 2). Seasonal homeowners in the California study area had higher household incomes (46 percent earned $80,000 or more) than permanent homeowners (29 percent). Colorado respondents had a demographic profile similar to California residents. The Colorado respondents were more likely to be male than female, hold high levels of education, and be either retired (44 percent of permanent and 42 percent of seasonal homeowners) or employed full-time (37 percent of permanent and 41 percent of seasonal homeowners). Seasonal homeowners in the study area of Colorado held high levels of household income (58 percent earned $80,000 or more in comparison to

permanent homeowners at 23 percent), and permanent homeowners earned lower income levels (30 percent earned $40,000 or less in comparison to seasonal homeowners at 8 percent). Florida respondents also tended to be male and employed full- or part-time. Permanent Florida homeowners tended to have lower levels of education (44 percent taking classes or graduating from high school and not going on to college) and lower household incomes (31 percent earned $40,000 or less).

A description of fire protection was obtained from respondents to understand their perceptions of fire services. In the area studied in California, almost everyone perceived that their home was serviced by a fire department (table 3) and 93 percent indicated hydrants were present near their home. In the areas studied in Colorado and Florida, single digit proportions of the homeowners indicated that there was not fire department service or that they weren't sure if there was. For hydrants, 63 percent of Colorado permanent homeowners indicated a hydrant was present compared to 87 percent of Colorado seasonal homeowners. In Florida, slightly less than half of the permanent homeowners indicated hydrants were present compared to 58 percent of seasonal homeowners.

Respondents were also asked whether someone in their household had respiratory or breathing problems. The range of households with reported conditions ranged from a low of 20 percent by seasonal Colorado homeowners to a high of 30 percent of the permanent homeowners in Florida.

Past Fuel Management and Wildfire Experiences

Respondents were asked whether they had certain wildfire-related experiences at any time in their life. These experiences were categorized into the following: fuel management practices, wildfire, and fire education or fire profession. Overall, experience levels differed across the three study sites as well as between permanent and seasonal homeowners. On fuel management practices, California homeowners were more likely to have been required to remove flammable vegetation on their property in comparison to Colorado or Florida homeowners (table 4). A large proportion of California homeowners appear to have complied with defensible space ordinances and permanent homeowners (68 percent) complied at a higher rate than seasonal homeowners (52

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	California (n=295)		Colorado (n=320)		Florida (n=324)	
	Perm. n=119	Season. n=176	Perm. n=254	Season. n=66	Perm. n=267	Season. n=57
	- - - - - - - - - - *Percent* - - - - - - - - - -					
Gender						
Male	53	61	76	68	70	79
Female	47	39	42	32	30	21
Employment status						
Employed, full- or part-time	42	45	37	41	52	45
Self-employed	10	10	16	14	12	9
Retired	42	43	44	42	33	46
Other	6	32	3	3	3	0
Household income levels						
Less than $40,000	28	21	30	8	31	11
$40,000 to $79,999	43	33	47	34	48	39
$80,000 or more	29	46	23	58	21	50
Highest education experience						
Jr. or high school	16	21	23	11	44	30
College	61	52	44	47	43	32
Graduate school	23	27	33	42	13	38

Table 3.—*Home fire protection and breathing ailments*

	California		Colorado		Florida	
	Perm.	Season.	Perm.	Season.	Perm.	Season.
	- - - - - - - - - - *Percent* - - - - - - - - - -					
Service by fire department (perception of respondent)						
Yes	100	98	96	94	93	91
No	0	1	4	3	6	5
Not sure	0	1	0	3	1	4
Hydrants present (perception of respondent)						
Yes	93	96	63	87	49	58
No	7	4	37	13	51	42
Member of household suffers from respiratory or breathing problems						
Yes	27	25	21	20	30	28
No	73	75	79	80	70	72

percent). Experiences with mechanical fuel removal occurring near homes was fairly consistent across the states and homeowner groups with approximately 25 percent indicating experience. Drastic differences in experience with prescribed burning existed between Florida and California or Colorado homeowners. Approximately two-thirds of Florida homeowners had experience with prescribed burning occurring near their home, in comparison to approximately 15 to 20 percent of Colorado homeowners, and 45 percent of permanent and 8 percent of seasonal California homeowners.

The level of wildfire experiences varied by the type of experience, state, and type of homeowner. The least common experience was personal injury or property damage from a wildfire (table 5). The most observed experience was seeing the aftermath of a wildfire (range from 62 percent of Colorado seasonal homeowners to 85

Table 4.—*Past experiences with fuel management practices*

	California		Colorado		Florida	
	Perm.	Season.	Perm.	Season.	Perm.	Season.
	- - - - - - - - - - *Percent* - - - - - - - - - -					
Been required to remove flammable vegetation on property	67	69	12	9	3	5
Implemented a defensible space around residence	68	52[a]	45	37	23	26
Mechanical removal of trees occurred near home	23	22	27	26	28	28
Prescribed burn occurred near home	45	8[b]	18	15	69	65

[a]Seasonal homeowners were significantly different from permanent homeowners at the $p<.01$ level.

[b]Seasonal homeowners were significantly different from permanent homeowners at the $p<.001$ level.

Table 5.—*Past experiences with wildfire*

	California		Colorado		Florida	
	Perm.	Season.	Perm.	Season.	Perm.	Season.
	- - - - - - - - - *Percent* - - - - - - - - -					
Observed effects of wildland fires on forests	85	68[a]	75	62[b]	70	72
Experienced smoke from a wildfire	82	45[a]	69	61	80	83
Personally witnessed a wildfire	80	56[a]	64	55	63	70
Experienced a road closure due to a wildland fire	77	44[a]	26	26	42	46
Felt fear or anxiety as a result of a wildland fire	57	35[a]	27	24	28	33
Friends, family or neighbors suffered property damage from a wildland fire	29	10[a]	20	12	13	25[b]
Experienced discomfort or health problems from smoke caused by a wildland fire	19	9[b]	14	12	26	21
Suffered property damage from a wildland fire	5	1[a]	5	5	5	5
Been personally injured by a wildfire	3	1	2	0	1	7

[a]Seasonal homeowners were significantly different from permanent homeowners at the p<.001 level.
[b]Seasonal homeowners were significantly different from permanent homeowners at the p<.05 level.

percent of California permanent homeowners). Over 50 percent of all respondent groups had also experienced smoke from a wildfire (with the exception of seasonal California homeowners at 45 percent) and had personally witnessed a wildfire. On many wildfire experiences, California permanent homeowners were more likely to have experience than seasonal homeowners.

Past involvement in fire education and the fire profession also varied across the types of experiences, state, and type of homeowner. The most common experience for homeowners was reading information on home protection from wildland fires with 7 out of 10 homeowners in California and Colorado and 4 out of 10 in Florida (table 6). Some of the lowest levels of experience were with homeowners asking a local fire department or forest rangers about reducing the risk of property damage caused by wildland fire. In California, permanent homeowners (34 percent) were more likely to have attended a public meeting about wildland fire than seasonal homeowners (7 percent).

Attitude and Approval Ratings

Homeowners' attitudes and approval of fuel management approaches varied across fuel treatment type and state. California homeowners, particularly permanent ones, were most positive and supportive of defensible space as a fuel reduction technique (tables 7 and 8). They also were positive about and supportive of mechanical fuel reduction. On average, California permanent homeowners rated their attitude toward prescribed burning as leaning toward negative. Colorado homeowners were most positive toward defensible space (fig. 4), followed closely by mechanical fuel reduction. They rated their attitude toward prescribed burning, on average, as being neutral;

Table 6.—*Past involvement in fire education and fire profession*

	California		Colorado		Florida	
	Perm.	Season.	Perm.	Season.	Perm.	Season.
	- - - - - - - - - - *Percent* - - - - - - - - - -					
Read information on home protection from wildland fires	74	70	72	70	37	42
Attended a park or forest interpretive program about wildland fire	34	10[a]	14	17	9	12
Attended a public meeting about wildland fire	34	7[a]	18	15	5	9
Worked with wildland fires as a part of my job or as a volunteer	19	7[b]	29	17[c]	18	14
Worked with local fire department on neighborhood and community fire protection	19	6[a]	29	26	14	16
Asked local fire department about how to reduce risk of property damage from wildland fire	13	6[c]	18	18	5	14[b]
Asked forest rangers how to reduce the risk of property damage caused by wildland fire	12	3[b]	7	9	6	9

[a]Seasonal homeowners were significantly different from permanent homeowners at the p<.001 level.
[b]Seasonal homeowners were significantly different from permanent homeowners at the p<.01 level.
[c]Seasonal homeowners were significantly different from permanent homeowners at the p<.05 level.

however, they gave slightly higher ratings on approval of the use of prescribed burning. Florida homeowners were most positive toward prescribed burning and gave slightly higher approval ratings to the use of this fuel reduction technique. Their attitude was positive on mechanical fuel reduction and defensible space, but less positive than their attitudes toward prescribed burning.

DISCUSSION

Homeowners in the three parts of the United States studied differed in terms of wildfire-related experiences and attitude toward and approval of fuel reduction techniques, specifically prescribed burning, mechanical fuel reduction, and defensible space. California homeowners living in the Big Bear Lake area in the San Bernardino National Forest, particularly permanent homeowners, were more likely to have had past experience with defensible space practices. They also had very high levels of wildland fire experiences including observing the aftermath of wildland fires, experiencing wildland fire smoke, being limited by road closures, and feeling fear and anxiety from wildland fires. These experiences show up in their attitude and approval ratings of fuel reduction techniques because homeowners were much more favorable and supportive, particularly permanent homeowners, of defensible space and neutral toward prescribed

Table 7.—*Attitudes toward fuel management approaches*

Fuel management approach	California		Colorado		Florida	
	Perm.	Season.	Perm.	Season.	Perm.	Season.
	- - - - - -		*Mean[a] (Standard error)*		- - - - - -	
Prescribed burning	-.2 (.20)	0.1 (.16)[b]	0.5 (.13)	0.2 (.26)	2.0 (.09)	1.7 (.24)
Mechanical fuel reduction	1.7 (.15)	1.4 (.12)	1.5 (.11)	1.4 (.22)	1.7 (.10)	1.6 (.21)
Defensible space	2.2 (.12)	1.5 (.13)	1.7 (.11)	1.8 (.19)	1.4 (.11)	1.2 (.24)

[a] Scale where -3 represents an extremely negative attitude, 0 represents a neutral attitude, and 3 represents an extremely positive attitude.

[b] Seasonal homeowners were significantly different from permanent homeowners at the $p<.001$ level.

Table 8.—*Approval of fuel management approaches*

Fuel management approach	California		Colorado		Florida	
	Perm.	Season.	Perm.	Season.	Perm.	Season.
	- - - - - -		*Mean[a] (Standard error)*		- - - - - -	
Prescribed burning	0.1 (.20)	0.1 (.15)	0.8 (.12)	0.9 (.24)	2.1 (.09)	2.2 (.16)
Mechanical fuel reduction	1.1 (.17)	1.2 (.13)	1.2 (.12)	1.0 (.19)	1.1 (.11)	1.1 (.23)
Defensible space	1.8 (.17)	1.4 (.13)	1.8 (.09)	1.9 (.17)	1.3 (.11)	1.2 (.18)

[a] Scale where -3 represents strongly disapprove, 0 represents neither approve or disapprove, and 3 represents strongly approve.

Figure 4.—*Permanent homeowners practicing defensible space with building materials and gardening, Delta County, Colorado.*

burning. Colorado homeowners living in several counties surrounding the Grand Mesa, Uncompahgre, and Gunnison National Forests/Bureau of Land Management public lands were similar to California respondents in their positive attitude toward and approval of defensible space and mechanical fuel reduction. A smaller proportion of Colorado homeowners (in comparison to California homeowners) had experiences with wildland fires, fuel reduction techniques, and fire education and professional work. In California, permanent homeowners were sometimes different from seasonal homeowners, particularly in experiences; however, these differences were not found with the two residency types in Colorado. For example, in Colorado permanent and seasonal homeowners were similar to each other on past wildfire-related experiences.

Florida homeowners were quite different from California and Colorado homeowners. Not every homeowner in Florida indicated that fire protection was available, and almost half of the homeowners indicated that no nearby hydrants were available to supply water to firefighters. Two-thirds of the Florida homeowners studied had experienced a prescribe burn near their home in the Apalachicola National Forest (where several hundred thousand acres are prescribed burned each year). The lowest proportion of homeowners who read information on home protection from wildland fires was found in Florida (4 out of 10 homeowners compared to 7 out of 10 in California and Colorado). Considering these types of experiences, Florida homeowners were most favorable and supportive of prescribed burning. Florida homeowners were also quite favorable toward mechanical fuel reduction, but approval of using mechanical fuel reduction was slightly lower.

The research presented here shows the diversity in homeowners' experiences and opinions about fuel reduction techniques. Homeowners' past experiences with wildland fire and fuel reduction techniques, as well as fire prevention education and professional firefighting positions, show the mosaic of wildland fire knowledge that homeowners living in the wildland-urban interface possess. Surprisingly, in statistical testing between permanent and seasonal homeowners, few significant differences were found except for selected experiences that were more common with permanent homeowners than seasonal homeowners, particularly in the California study site. Some of this is to be expected because seasonal home owners spend less time in the area (fig. 5) where wildland fires might occur or defensible space programs are being demonstrated. Fire managers, resource planners, and Firewise educators can use the findings of this research to further identify areas where education is needed to encourage homeowners to reduce the risk of losing their home to wildland fire, and gauge where further support is needed for fuel reduction techniques that may increase social, environmental, and economic benefits.

Figure 5.—*Seasonal homeowner cabin in San Bernardino National Forest, California.*

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ANTECEDENTS TO ATTITUDES TOWARD PRESCRIBED BURNING, MECHANICAL THINNING, AND DEFENSIBLE SPACE FUEL REDUCTION TECHNIQUES

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ABSTRACT.—As fire policy and management take on a greater role in land agencies, a better understanding is needed of public opinion, particularly of homeowners who are most affected by wildland fires. This research assessed homeowners' attitudes toward three fuel management approaches—prescribed burning, mechanical fuel reduction, and defensible space ordinances—in three areas of the United States (California, Florida, and Michigan). Although attitudes varied for the management approaches across regions, most were positive. The personal importance of each fuel treatment and overall trust in the government managing public lands were found to be related to the direction (positive, neutral, negative) of the attitude held toward the fuel treatment.

Across the United States, particularly in rapidly growing wildland-urban interface (WUI) areas of the West, the coexistence of people and the ecosystems in which they live is under increasing stress. One stressor in the wildland-urban interface areas is the threat of wildland fire (Cohen 2000, Davis 1990). Wildland fires can be ignited by humans, for example, through arson, escaped campfires, discarded cigarettes, or backyard burning of garbage. Wildland fire can also result from lightning strikes. Today more people live and recreate in areas prone to wildfires, thus fire protection is in greater demand. Enormous expenditures, mostly Federal, but also State and local, are devoted to fire protection with taxpayers bearing these costs.

Survey research conducted at State or regional scales has assessed public opinion about fire and fuels management. Schindler and Reed (1996) found more support for mechanical thinning than for prescribed burning with residents of northeast Oregon's Blue Mountains. Winter (2002) recently found that California residents were supportive of letting some fires burn, but were more supportive (by a factor of two) of protecting residences than extinguishing all fires regardless of cost. Loomis *et al.* (2001) found that residents of central Florida were supportive of prescribed burning and that a greater proportion of residents held more positive attitudes after receiving public education materials on prescribed burning than those not receiving information.

Fewer studies have targeted residents living in or adjacent to wildland areas where significant financial resources are spent on fire protection and risk reduction. In a study of homeowners in Crawford County, Michigan, Winter and Fried (2000) found support for mechanical fuel reduction on public lands and weak support for defensible space practices and prescribed burning. Also reported in their study was the notion that land agencies and homeowners should share responsibility for fire risk reduction because fuel reduction efforts do not, by themselves, guarantee that a wildfire will leave private property and homes undamaged. It is in these WUI areas, where home construction continues, that fire and resource managers face the greatest challenges. The opinions of WUI homeowners, those who face the possibility of losing their lives, homes, and belongings in a wildfire, influence the political environment confronting managers charged with achieving a balance between allowing natural processes to occur and protecting homes and lives.

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To assess and understand attitudes held by homeowners in WUI areas, we used the theory of reasoned action (Ajzen and Fishbein 1980) as a framework for measuring beliefs about, attitudes toward, and intentions to support fuel management approaches in WUI areas. Others have used and extended this theory by considering ancillary factors that influence the primary components of the reasoned action model. In a study of hunters, Rossi and Armstrong (1999) found that past experience with hunting explained significant variation in intention to hunt. Bright and Manfredo (1995, 1997) reported that personal relevance moderated the effect information had on people's attitudes toward natural resource management. At high levels of personal relevance of an issue, information had a greater effect on attitudes. At low levels of personal relevance, information had a less central role in changing attitudes. Bright *et al.* (1993) found that visitors to Yellowstone National Park responded differently to communications targeted to change beliefs, attitudes, and intentions for controlled burning depending on their initial attitude direction (positive, negative). The communication message was more effective in altering cognitive responses of visitors who initially held positive attitudes than of those visitors who initially held negative attitudes toward controlled burning in the park.

During focus group interviews with wildland-urban interface homeowners in California, Florida, and Michigan, trust in forest management agencies emerged as an important factor in the decision to support or oppose fuel management approaches (Winter *et al.* 2002). These observations conformed primarily to the "competence" dimension of social trust wherein "trust is gained only when the individual or institution in a social relationship is judged to be reasonably competent in its actions over time" (Kasperson *et al.* 1992). In their study of support for the siting of a nuclear waste repository among Nevada residents, Flynn *et al.* (1992) found that the level of trust in those responsible for repository management directly influenced risk perceptions, which, in turn, directly affected attitude toward the repository.

In this study, we assessed attitudes toward three fuel management approaches in WUI areas in California, Florida, and Michigan. We tested the statistical dependence of attitudes about fuel management approaches on 1) past experience with the fuel management approach, 2) personal importance of the fuel management approach, and 3) overall trust in land managers' capacity to carry out fuel management effectively and safely. The intention of this analysis was to assess the feasibility of extending the reasoned action model, as applied to fire management, to better predict the antecedents to a homeowner's intention to support the implementation of each fuel management approach where they live.

METHOD

Site Selection

Our research design targeted several areas of the United States to illuminate regional variation. The purpose of the study is to provide land management agencies an assessment of homeowners' opinions about fuel management approaches. Prior to collecting data on large samples of homeowners in the selected study sites, we conducted focus groups with homeowners and agency managers at four sites in three states that offered substantial diversity (results reported in Winter *et al.* 2002). In addition to these sites, a dozen other areas were considered as possible study sites on the basis of fire history, population density, wealth demographics, type of ecosystems, and current fuel treatment norms. Clay County, in north central Florida, and Oscoda County, in the northern Lower Peninsula of Michigan, were selected for inclusion in the focus group and the mail questionnaire stages of the research. El Dorado and Placer Counties in the central Sierra foothills of northern California were selected for inclusion in the mail questionnaire only. The Michigan survey site was expanded to Crawford and Ogemaw Counties to ensure that the survey targeted homeowners subject to wildland fire risk.

Study Site Descriptions

The California study site contains a mix of oak woodland, pine, and mixed conifer forests, with much of the forested wildland managed by the USDA Forest Service (El Dorado and Tahoe National Forests). Wildfires are frequent (several hundred per year), and prescribed burns are rare and very limited in scope and size. Defensible space ordinances are enforced by the California Department of Forestry and Fire Protection. The Florida site contains primarily pine forest and is almost entirely under private

ownership (i.e., wood product companies). The Michigan site contains primarily jack pine forests. Both Federal- (Huron Manistee National Forest) and State- (Au Sable State Forest) managed forests exist in the area. There are moderately frequent wildland fires and prescribed burns. In Florida and Michigan, unlike California, defensible space was not a local or State ordinance.

Data Collection Procedures

Data were collected in a mail questionnaire in fall 2001 (California and Florida) and spring 2002 (Michigan). Homeowner lists were obtained from county tax assessors at each study site. For California and Florida, GIS data for parcels and natural features were available to assist in selecting the samples. For Michigan, more spatially coarse techniques were used to identify areas where homeowners face the risk of wildfires. In all three states, extensive discussions were held with Federal and/or State agency foresters and fire managers to refine our area selection. Thus, our sample represents specific areas of each county where homeowners and potentially flammable vegetation fuels were present. Only properties for which tax assessor records indicated the presence of a structure with a value of at least $10,000 were treated as part of the population of interest (to eliminate vacant lots). In all areas, single family homes and mobile homes were considered to belong to the population of interest. In California and Florida, a sample was created using geographical cluster sampling with random offsets to ensure adequate sample sizes for each geographical separation class for a related geostatistical study of spatial continuity in fuel management acceptance. In Michigan, the budgeted sample size matched the identified population so that all homeowners in the population of interest were surveyed.

A modified Dillman (1978) mail procedure was used whereby each household in the sample received an initial mailing comprised of a personalized letter, business reply envelope, and a questionnaire. A reminder postcard was sent 1 week later. Three weeks after the initial mailing, nonrespondents were sent a packet similar to the first mailing. In California and Florida, approximately 1,200 homeowner households were sampled; in Michigan, where a larger budget was dedicated to the homeowner survey, approximately 2,400 households were sampled (table 1). The highest response rate was received in Michigan with 53 percent, followed by California with 49 percent and Florida with 31 percent.

Measurement and Data Analysis

The questionnaires used at each site were identical except for the description of the area of interest, were critiqued by several fire researchers and fire managers, and were pretested with focus group participants (who were contacted after our initial focus groups) before survey work began. The questionnaire was printed in a booklet form that included a cover page showing a map of the local area, an introductory page containing directions and definitions of the three fuel management approaches, and six pages of questions. Questions were designed to assess past experiences with wildfire and fuel management approaches, length and type of residency, personal importance or relevance of each fuel treatment, attitudes toward each fuel treatment, trust in land managers carrying out fuel treatments, and descriptive social and demographic attributes. All the opinion-type questions (e.g., attitudes, importance, trust) used seven-point scales so that respondents could express the degree to which they were positive (important; agreed) or negative (not important; disagreed).

Table 1.—*Sample sizes and response rates for each study site*

Study sites	Original sample size	Bad addresses	Effective sample size	Respondents	Response rate
	Frequency				*Percent*
California	1,200	90	1,110	544	49
Florida	1,197	54	1,143	357	31
Michigan	2,453	101	2,352	1,253	53

In the fuel treatment section, prescribed burning was defined as: "also called controlled burning, this practice can involve allowing a naturally caused fire to burn under close and careful watch; or intentionally setting fires in ways that can be controlled to produce desired conditions and protect against undesirable conditions." Mechanical fuel reduction was defined as: "these methods vary widely. Resource managers can use chainsaws, brush mowers, or other specialized machines to reduce the number of shrubs and small trees where they are so numerous that they increase the risk and size of wildfires." Defensible space ordinance was defined as: "this approach requires homeowners to create and maintain a fire-safe zone around their homes by removing flammable vegetation within 30 feet of their home. It would also require that yard trees and shrubs be no closer than 15 feet apart and that the lower limbs of trees be pruned to a height of 15 feet from the ground or greater." Personal relevance was considered as a construct to measure the salience or attention an individual has to fuel management approaches. Based on pretesting of various scales and question/response wording, an importance scale was selected as the means of assessing an individual's psychological "attention" to fuel management approaches. Importance of each of the three fuel management approaches was framed with the following question introduction: "Governments have programs or ways of improving communities and quality of life. Not all of these programs have the same importance to citizens. How important are these programs to you personally as they are practiced in your local area?" The question on trust in government resource agencies was framed as "how would you rate the government agencies that manage wildland in (local area specified)."

Analysis for this paper used primarily descriptive and bivariate analyses to explore possible relationships between variables and patterns across the three study sites and fuel management approaches. After presenting the attitude mean scores, we reduced the seven-point attitude scales to three groups (positive, neutral, and negative) to simplify the presentation of the results. Bivariate analyses included Pearson Chi-square, an appropriate test for ordinal and nominal data, and univariate analysis of variance for categorical variables and seven-point interval scales. For all significance tests, a $p<.05$ level was used to assess significance.

FINDINGS

Description of Respondents

California and Florida respondents were primarily permanent residents who lived in their homes 12 months a year (table 2). Four out of 10 Michigan respondents were seasonal or vacation homeowners. A majority of all respondents had lived longer than 10 years in the area being studied. Males were more likely to be respondents to the mail survey. California and Michigan respondents had higher levels of education than respondents from Florida. Florida respondents had the lowest household income levels and California had the highest.

Descriptive Results of Fuel Treatment Attitude, Past Experience, Personal Importance, and Trust in Government Agencies

Respondents from the three study sites held different attitudes toward each of the fuel management approaches. California respondents held strong positive attitudes toward mechanical fuel reduction (mean=5.8 on seven-point scale) on public land and defensible space ordinances (mean=5.8) for their own property (table 3). Florida respondents held a strong positive attitude toward prescribed burning (mean=5.7). Michigan respondents, on average, were neutral on all three fuel management approaches with mechanical fuel reduction rated slightly positive (mean=5.0). To carry out the remaining analysis, we collapsed the seven points into three groups—positive (5, 6, and 7 on the scale), neutral (4), and negative (1, 2, and 3). Similar to the mean results, California homeowners were positive (modal category) on all three fuel management approaches (table 4). Florida homeowners were also positive (mode) on all three fuel treatment approaches, but less than 50 percent of the respondents were positive on defensible space. Michigan homeowners were also positive (mode) on all three fuel treatments, but only with mechanical fuel reduction techniques were more than 50 percent of the respondents positive.

Respondents also reported very different past experiences with each of the fuel management approaches. California respondents had extremely high levels (91 percent) of experience actually removing flammable vegetation with

Table 2.—*Description of respondents*

	California (n=544)	Florida (n=357)	Michigan (n=1,244)
		Percent	
Type of residency			
Permanent	89	97	60
Seasonal	7	1	38
Other	4	2	2
Residency length			
1-10 years	40	33	32
11 years or more	60	67	68
Gender			
Male	70	60	71
Female	30	40	29
Household income levels			
Less than $40,000	23	33	34
$40,000 to $79,999	45	49	37
$80,000 or more	32	18	29
Highest education attainment			
High school	26	45	35
Some college	38	39	33
College graduate	36	16	32

Table 3.—*Attitudes toward fuel management approaches for three study sites*

Fuel management approach	California	Florida	Michigan
	Mean[1] (Standard deviation)		
Prescribed burning	5.1 (1.7)	5.7 (1.4)	4.0 (1.9)
Mechanical fuel reduction	5.8 (1.3)	5.3 (1.5)	5.0 (1.6)
Defensible space	5.8 (1.6)	4.3 (1.9)	4.2 (2.0)

[1] Scale where 1 represents extremely negative, 4 represents neutral, and 7 represents extremely positive.

Table 4.—*Attitudes (grouped) toward fuel management approaches for three study sites*

Fuel management approach	California			Florida			Michigan		
	Pos.[a]	Neut.	Neg.	Pos.	Neut.	Neg.	Pos.	Neut.	Neg.
					Percent				
Prescribed burning	66	18	16	78	17	5	42	23	36
Mechanical fuel reduction	79	17	4	64	28	8	57	29	14
Defensible space	79	13	8	42	30	28	42	27	32

[a] Attitude scale was categorized into three groups: positive attitude (points 5, 6, and 7 on the scale); neutral (4 or midpoint), or negative attitude (points 1, 2, and 3).

only 32 percent indicating that they were required to remove flammable vegetation (table 5). Two-thirds of the California respondents had experienced smoke discomfort from wildfires and about 2 in 10 homeowners had experienced either a prescribed burn or a mechanical fuel reduction near their home. Florida respondents were most likely (61 percent) to have experienced smoke discomfort from wildfires, followed by removing flammable vegetation (44 percent). A greater proportion (31 percent) of Florida respondents had experienced prescribed burning near their home than California (25 percent) or Michigan respondents (21 percent). Michigan respondents had the lowest level of smoke discomfort from wildfires (possibly because of the high number of part-time residents who do not use their seasonal home during spring and fall prescribed burns).

The personal importance of each of the three fuel management approaches had quite similar results to the attitude scales. California respondents rated mechanical fuel reduction and defensible space equally (very important). Florida respondents rated prescribed burning as very important. Michigan respondents rated mechanical fuel reduction as the most important of the three fuel management approaches.

The highest level of trust was described as "the government doing a good job of protecting private property from wildland fires" (table 6). California respondents had the highest rating on this scale (mean of 5.2 on a seven-point agreement scale), followed by Florida (mean=4.9) and Michigan (mean=3.9). The other scale items measuring trust were rated, on average, at a neutral level. Florida homeowners were slightly more trusting (mean=4.5) of the use of prescribed burning than California (4.1) or Michigan (3.3) homeowners, although California homeowners gave agencies a higher trust score on notifying the public about upcoming prescribed burns than Florida or Michigan homeowners.

Table 5.—*Experience with and personal importance of fuel management approaches for three study sites*

	California	Florida	Michigan
		Percent	
Past experience with			
Prescribed burning near home	25	31	21
Smoke discomfort from wildfires	68	61	17
Mechanical fuel reduction near home	21	5	9
Required to remove flammable vegetation on property	32	2	2
Actually removed flammable vegetation on property	91	44	42
		Mean (Standard deviation)	
Personal importance of[a]			
Prescribed burning	5.2 (1.7)	5.8 (1.3)	4.6 (1.9)
Mechanical fuel reduction	5.7 (1.4)	5.4 (1.5)	4.9 (1.7)
Defensible space	5.8 (1.6)	4.5 (2.0)	4.4 (2.0)

[a] Scale where 1 represents not at all important to 7 represents extremely important.

Table 6.—*Level of agreement with statements about trust in the government agencies that manage wildland for three study sites*

Trust statements[a]	California	Florida	Michigan
	- - - - *Mean (Standard deviation)* - - - -		
I trust the government to make the proper decisions about the use of prescribed burning.	4.1 (1.8)	4.5 (1.7)	3.3 (1.8)
The government does a good job of notifying the public about upcoming prescribed burns.	4.0 (1.7)	3.6 (1.7)	3.4 (1.7)
I trust the government to make the proper decisions about the use of mechanical fuel reduction.	4.2 (1.6)	4.1 (1.6)	3.5 (1.7)
I trust the government to make the best decision about enacting and enforcing defensible space ordinances.	3.9 (1.7)	3.6 (1.8)	3.0 (1.7)
The government does a good job in managing public land.	3.9 (1.5)	4.1 (1.5)	3.5 (1.6)
The government does a good job communicating to the public about forest issues.	3.6 (1.6)	3.7 (1.6)	3.0 (1.6)
The government does a good job of protecting private property from wildland fires.	5.2 (1.5)	4.9 (1.5)	3.9 (1.7)

[a] Scale where 1 represents strongly disagree, 4 represents neutral, and 7 represents strongly agree.

Bivariate Analysis of Attitudes Toward Fuel Management Approaches and Possible Explanatory Variables

Homeowners in the selected study areas of California and Florida had approximately the same frequency of past experience with each of the fuel treatments regardless of whether they held a positive, neutral, or negative attitude toward that fuel treatment (table 7). In California, a pattern was observed where respondents with a positive attitude toward defensible space ordinances were more likely (93 percent of those with positive attitude) to have actually removed flammable vegetation from their property in comparison to those with a neutral attitude (89 percent of those with neutral attitude removed vegetation) and a negative attitude (77 percent of those with negative attitude removed vegetation).

In Michigan, attitude levels were more closely related to past experience with fuel treatments. Respondents with negative attitudes toward prescribed burning were more likely to have had a prescribed burn occur near their home (30 percent of negative attitude respondents experienced prescribed burn, 17 percent of positive, and 14 percent of neutral) or had discomfort from smoke caused by wildfire (23 percent of negative attitude respondents experienced smoke discomfort, 14 percent of positive, and 13 percent of neutral) in comparison to

respondents who held a neutral or positive attitude toward prescribed burning (table 7). Similar to California respondents, Michigan respondents with a positive attitude toward defensible space ordinances were more likely (53 percent of those with positive attitude) to have actually removed flammable vegetation from their property in comparison to those with a neutral attitude (36 percent) or a negative attitude (34 percent).

Respondents with a positive attitude toward any of the three fuel management approaches were significantly more likely to rate the personal importance of the fuel approaches as being more important in comparison to those who held neutral or negative attitudes toward a fuel approach (table 7). This pattern was found across all three fuel treatments in each of the study site areas.

Finally, the level of trust in the government to manage wildland was found to be higher amongst those with positive attitudes toward any of the three fuel management approaches across the three study sites (table 7). Respondents with negative attitudes toward the fuel treatment approaches disagreed, on average, that the government can effectively manage wildland including wildfire, prescribed burning, mechanical fuel reduction and defensible space ordinances.

DISCUSSION

The results from the three areas studied suggest that attitudes toward prescribed burning, mechanical fuel reduction, and defensible space ordinances differ in various parts of the United States. For all three areas and fuel management approaches, the greatest number of respondents held positive attitudes. However, sizable segments of homeowners held neutral or negative attitudes about one or more fuel management approach. In both Florida and Michigan, 58 percent of respondents held either neutral or negative attitudes about defensible space ordinances, and in Michigan, 58 percent of respondents were neutral or negative towards prescribed burning, too.

Based on the theory of reasoned action, we would expect beliefs to be a strong predictor of attitudes and attitudes to be a strong predictor of intentions (i.e., to support a fuel treatment approach). Other researchers using this theory to explain public support and actions have found that additional social science variables (e.g., subjective norms, personal relevance, perceived behavioral control) helped predict attitudes, intentions or behaviors. Our results show that personal importance is a good predictor of attitude groups (i.e., positive, neutral, negative) across all three fuel management approaches and study areas. Overall trust in the government to manage wildland was also a good predictor of attitudes particularly in understanding homeowners with a negative attitude toward a fuel management approach. Past experience with a fuel management approach was not universally a good predictor of attitude levels. In California and Michigan, homeowners who actually practiced defensible space on their property were more likely to hold positive attitudes toward defensible space; however, there were still homeowners who practiced defensible space (with an ordinance in effect) and did not approve of it as a government policy.

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Table 7.—*Bivariate relationships between attitude toward each fuel management approach and past experience, personal importance, and overall trust in government for three study sites*

Explanatory variables	Attitude	California				Florida				Michigan			
		Pos.[a]	Neutral	Neg.	Sign[b] test	Pos.	Neutral	Neg.	Sign test	Pos.	Neutral	Neg.	Sign test
		- Percent yes -				- Percent yes -				- Percent yes -			
Past experience with													
Prescribed burning near home	PB	26	20	29	ns	35	18	28	s*	17	14	30	s***
Smoke discomfort from wildland fires	PB	66	65	79	ns	61	57	67	ns	14	13	23	s***
Mechanical fuel reduction near home	MFR	24	5	32	s***	8	2	0	ns	11	5	11	s**
Required to remove flammable vegetation on property	DS	33	37	23	ns	1	3	0	ns	2	2	1	ns
Actually removed flammable vegetation on property	DS	93	89	77	s**	47	36	46	ns	53	36	34	s***
		- - Mean - -				- - Mean - -				- - Mean - -			
Personal importance of[c]													
Prescribed burning	PB	5.0	4.4	3.3	s***	5.7	4.4	2.7	s***	5.5	4.2	3.7	s***
Mechanical fuel reduction	MFR	6.1	4.6	3.8	s***	6.0	4.4	4.0	s***	5.6	4.1	3.8	s***
Defensible space	DS	6.3	4.5	2.7	s***	6.1	4.8	4.5	s***	5.7	4.2	3.0	s***
Trust[d]													
Overall trust in government	PB	4.4	4.1	3.1	s***	4.3	4.3	3.5	s***	3.9	3.5	2.7	s***
Overall trust in government	MFR	4.2	4.0	3.3	s***	4.2	4.1	3.6	s**	3.6	3.3	2.9	s***
Overall trust in government	DS	4.2	3.9	3.4	s***	4.2	4.0	3.2	s**	3.6	3.4	3.0	s***

[a] Attitude was categorized into three groups: positive attitude (points 5, 6, and 7 on scale); neutral (4 or midpoint), or negative attitude (points 1, 2, and 3).

[b] s=the statistical test estimated a $p<.05$ level of association between the variables with * at $p<.05$, ** at $p<.01$, and *** at $p<.001$.

[c] Scale where 1 represents not at all important to 7 represents extremely important.

[d] Mean of the seven trust items, including items measuring each of the three fuel management approaches, where the values could range from 1 representing the government as very untrustworthy of managing wildland to 7 representing the government as very trustworthy. Cronbach's α

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CALIFORNIANS' OPINIONS ON WILDLAND AND WILDERNESS FIRE MANAGEMENT

Patricia L. Winter[1]

ABSTRACT.—To assess public attitudes and values regarding fires and fire management, a telephone survey was conducted of California residents. Most respondents were concerned about wildland and wilderness fires. The greatest percentage agreed that "we probably have to let some fires burn, but must protect residences." Fire management techniques were rated for expected effectiveness and approval. The trust measure, based on the shared values similarity model, was the most significant predictor in these ratings. Knowledge about fires, concern, and gender were also helpful predictors. The results are useful in understanding public perceptions of and reactions to fire management.

Public attitudes and values play an important role in fire management, given the potential impact on residents and on recreationists. The success of many fire management techniques rests on the public in two ways: through compliance with various regulations and recommendations (e.g., defensible space, and lighting of campfires in provided fire rings) and through acceptance of interventions that are legally permitted. Public attitudes and perceptions about fire and fire management will continue to increase in importance, as public interest in natural resource management issues increases (Shelby and Speaker 1990). Research suggests a mixed understanding of fire effects and fire policies, and the important role of managing agencies in educating the public (Manfredo *et al.* 1990). However, as Stankey (1996) points out, education will not necessarily lead to acceptance of an agency's preferred management technique.

Recent work by Winter, Vogt, and Fried (2002) suggests that acceptance of fuel management strategies (specifically, prescribed fire, mechanical treatment, and defensible space requirements) is affected by beliefs about fuel management outcomes, personal importance of fuel management, 'situational specificity' (for example, linked to size of the fuel treatment or proximity to developed areas), and trust in the agency (based on perceptions of its ability to control fires, professional skills, credibility, and communication).

Trust has been found to be an important component in attitudes toward a proposed recreational fee program (Winter *et al.* 1999), an existing fee recreation program (Borrie *et al.* 2002), and the management of threatened and endangered species on forest lands (Cvetkovich and Winter 2003, Winter and Knap 2002, Winter and Cvetkovich 2000). In each of these studies, trust was quantified according to variations on the shared values similarity model, based on similarity of values, goals, thoughts, direction, views, and overall trust (Earle and Cvetkovich 1995).

The present study extends the examination of public attitudes and perceptions of fire and fire management through a statewide survey of California residents that focused on general attitudes and perceptions about fire, ratings of approval and expected effectiveness of management interventions in wildland and wilderness areas, and the role of selected variables in understanding ratings of interventions.

METHOD

Questionnaire

A questionnaire for telephone administration using CATI (Computer Assisted Telephone Interviewing) was developed in both English and Spanish. It was modeled

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after prior surveys used by the author and her colleagues that were focused on attitudes toward threatened and endangered species management (Cvetkovich and Winter 2003, Winter and Cvetkovich 2000, Winter and Knap 2001, Winter *et al.* 1999). Items queried concern regarding wildland and wilderness fires in California, degree of knowledge about fires, shared values similarity and trust in the Forest Service regarding management of forest fires, respondent's general opinion about fire, approval and effectiveness of selected management interventions, forest visitation and annual outdoor recreation, and sociodemographics.

Procedure

A sample of residential telephone numbers was drawn from eight regional divisions in California: Bay Area, Central Coast, Central Valley, Inland Empire, Los Angeles, North Coast/Sierra, Orange County, and San Diego County (following the same groupings of California counties used by the California Field Poll). The total population for each of the regions in relation to the state population was determined, based on data from the State of California Department of Finance. These regional proportions were then used to create weights for the final data set. Only the weighted data are reported in this paper.

Respondents were randomly selected to participate in one of two survey forms; one survey form focused on fire and fire management, and the other focused on the management of threatened and endangered species. A target of 600 completed surveys per form (n = 1200) was set to obtain a 95-percent confidence interval, plus or minus 4 percent. Stratification was by region and gender. Assignment to a survey form followed the determination of the following contact criteria: reaching the adult in the household (18 and over) with the most recent birthday, willingness to participate in a phone survey, and gender. Once agreement to participate was secured from the appropriate individual, responses were entered directly into the CATI database. Most (90.8 percent) interviews were completed in English and took about 15 minutes. The final cooperation rate for both forms of the survey was 83.9 percent, with 606 respondents represented in the fire survey.

Description of Respondents

The vast majority of respondents (78.9 percent) had lived in the United States all of their lives. Ages of respondents ranged between 18 (the minimum for participation) and 65 years old. About one-third were less than 35 (32.9 percent), about one-fifth were between 35 and 44 (21.9 percent), and another fifth were between 45 and 54 (22 percent). Annual household income varied. Approximately one-fifth (21.5 percent) reported incomes of less than $25,000, about another fifth (21.6 percent) reported between $25,000 and $49,999, about one-third (17.0 percent) between $50,000 and $74,999, and slightly more than one-fourth $75,000 or more (table 1).

Table 1.—*Annual household income of respondents*

Income group	Frequency	Percent
Under $5,000	16	2.6
$5,000 to less than $10,000	27	4.4
$10,000 to less than $15,000	28	4.7
$15,000 to less than $25,000	59	9.8
$25,000 to less than $35,000	51	8.4
$35,000 to less than $50,000	80	13.2
$50,000 to less than $75,000	103	17.0
$75,000 to less than $100,000	65	10.7
$100,000 or more	84	13.9
Don't know/refused	93	15.4
Total	606	

Many of the respondents were well educated, with 18.4 percent reporting completion of at least some graduate work, and 20.7 percent a bachelor's degree or equivalent. Only 7.6 percent reported ending their educational careers with middle school or lower grades. Respondents selected a variety of ethnic and racial categories to describe themselves; a majority were white (table 2).

Very few were members of environmental organizations, although about 3 percent (2.9) reported membership in the Sierra Club and less than 2 percent (1.6) reported membership in the World Wildlife Federation. On an annual basis, outdoor recreation participation was

Table 2.—*Ethnic and racial categories selected by respondents*

Category	Frequency	Percent[a]
White or Caucasian	364	60.1
Hispanic or Latino/a	131	21.6
Asian or Pacific Islander	47	7.7
Black or African American	24	4.0
Native American or First Nations	17	2.9
Other	19	3.1
Missing	16	2.7

[a]Sum of percent is not equal to 100 because not all respondents selected a category or categories for ethnic/racial identity, while others (1.9 percent) selected more than one category.

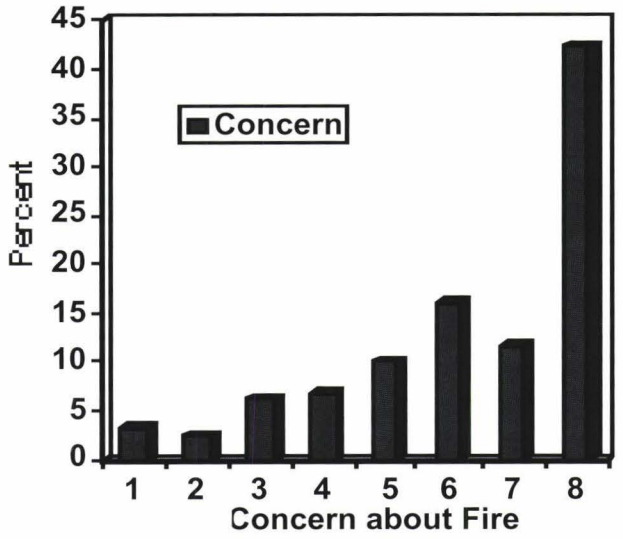

Figure 1.—*Respondents' ratings of concern about wildland and wilderness fires. (1=not at all concerned, 8=very concerned); n=598.*

reported by almost half of the respondents as several times weekly (27.7 percent) or monthly (21.8 percent), while only 16.0 percent recreated in the out-of-doors "rarely or never." A majority (73.3 percent) had made at least one visit to a national forest in California in the past 12 months, with an average of 4.6 (mean, SD=26.4, n=435) visits to forest lands. Average number of years since first visit among those who had visited forest lands was 24.5 years (mean, SD=16.1, n=431).

RESULTS

Concern About Wildland and Wilderness Fires

Respondents were asked to report how concerned they were about wildland and wilderness fires in the state (on a scale from 1=not at all concerned to 8=very concerned). Average concern was above the middle of the scale at 6.3 (mean, SD=2.0, n=598). More than two-thirds (69.9 percent) placed their concern at 6, 7, or 8 on the scale (fig. 1).

Shared Values Similarity and Trust

Shared values similarity and trust in the Forest Service to manage wildland and wilderness fires were assessed through a series of three items. Shared values were measured by asking about values and goals. In both items, respondents rated similarity to the Forest Service on an 8-point scale, with 1=a dissimilarity anchor, and 8=a similarity anchor (e.g., "The Forest Service does not share your values" represented dissimilarity). Then, respondents were asked the extent of their overall trust in the Forest Service to manage fires on a scale from 1 to 8 (1=do not trust the Forest Service at all, 8=trust the Forest Service completely).

A trust scale was created from the mean of the two measures assessing shared values similarity and the single item assessing overall trust in the Forest Service. The scale had high inter-item correlations paired with a favorable Cronbach's alpha reliability coefficient of .78 (table 3). Respondents indicated a fairly high degree of trust in the Forest Service to manage forest fires (mean of 6.83) as well as perceived shared values and goals.

General Opinions about Fire and Fire Management

Three general attitudinal statements regarding wildland and wilderness fire management were read to respondents, who were asked to select the one statement that best represented their opinion. The greatest number (60.1

Table 3.—*Means, standard deviations, and intercorrelations among trust scale items (n=489)*

Scale item	Mean	SD	Trust	Goals
The Forest Service shares your values.[a]	6.22	1.95	.492	.664
The Forest Service has the same goals.[b]	6.05	2.08	.467	
You trust the Forest Service completely in their efforts to manage forest fires.[c]	6.83	1.70		

[a] 1 = "The Forest Service does not share your values"; 8 = "The Forest Service shares your values"
[b] 1 = "The Forest Service has different goals"; 8 = "The Forest Service has the same goals"
[c] 1 = "You do not trust the Forest Service at all"; 8 = "You trust the Forest Service completely"

percent) felt that "We probably have to let some fires burn, but must protect residences" represented their opinion, while about one-third (31.5 percent) selected "All fires must be extinguished regardless of cost." Very few (5.4 percent) selected "Fires must be allowed to take their natural course when burning in wildland or wilderness areas, even if structures are involved."

Knowledge and Perceptions of Fire and Fire Management

A series of statements was read to respondents, who were asked to indicate if they thought each statement was true or false regarding wildland and wilderness fires. A majority of the statements were rated as 'true' by most respondents, although less than half agreed "controlled burns are likely to burn up more area than planned" (table 4). In the majority of cases, 'true' was considered the correct response and a reflection of knowledge about wildland and wilderness fires. A new variable was created from the total of all 'true' responses on the true/false items, with two of the statements excluded ("views along the road and along trails are less scenic following a fire" and "controlled burns are likely to burn up more area than planned") because the statements were better suited as perceptual measures than measures of knowledge.

Approval and Effectiveness of Selected Management Interventions

Respondents were asked to judge their approval (8=strongly approve, 1=strongly disapprove) and the effectiveness (8=highly effective, 1=not effective) of six interventions for the management of fires in wildland or wilderness areas (table 5). The methods included a range of options focused on recreation and a range of general options focused on forest lands (see table for full wording of each item). Use of information signs received the highest average approval rating; bans on mechanically based uses had the lowest average approval and effectiveness ratings.

All effectiveness and approval items were submitted to a Principal Components Analysis with varimax rotation, and four factors were identified (table 6). Effectiveness and approval items were then grouped, based on factor loadings, for scale analyses. The first factor included the approval and effectiveness ratings for banning some uses and closing some areas (Chronbach's α = .79). These two recreation-based interventions tend to be more intrusive than the ones loading heaviest on the second factor. Use of information signs and restrictions on some uses were included in the second factor (Chronbach's α = .70). The third factor included the effectiveness and approval of mechanical treatments, such as chipping (Chronbach's α = .90). Approval and effectiveness ratings of controlled burns were included in the fourth factor (Chronbach's α = .82). The mean of the items within each of these factors was calculated and saved as new intervention rating variables for use in further analyses.

Table 4.—*Knowledge and perceptions of fire and fire management*[a]

Statement	True	False	Don't know/Refused
		Percent	
Controlled burns reduce the risk of larger, uncontrolled fires.	90.5	6.4	3.1
Fire means danger to residences and other important structures.	89.5	8.9	1.6
There are proven management techniques for fire prevention and suppression.	82.8	6.9	10.1
People have difficulty breathing due to poor air quality after a fire.	82.8	13.6	3.6
Prescribed fires are used to accomplish certain land management objectives.	80.3	10.0	9.7
Views along the road and on trails are less scenic following a fire.*	77.7	16.4	5.9
Fire is a natural ecosystem process.	77.4	16.9	5.8
The health of vegetation is improved following a controlled burn.	74.2	17.4	8.4
Fires lead to improved survival of native plants.	52.1	33.8	14.1
Controlled burns are likely to burn up more area than planned.*	40.7	49.1	10.2

[a] The best answer for all responses is 'true', although * denotes the two items that would rely more heavily on perception than fact.

Table 5.—*Approval and effectiveness of selected management interventions*

Method	Approval[a]			Effectiveness[b]		
		Mean			*Mean*	
	SD		*N*	*SD*		*N*
If the Forest Service were to have signs at recreation sites informing forest users of fire risks and how they can help prevent fires	1.2	7.4	602	1.8	6.3	600
If the Forest Service were to close some areas during fire season, but keep the majority of the areas open to use	2.1	6.6	592	2.0	6.4	586
If the Forest Service were to make certain restrictions on uses of wildland and wilderness areas, for example, allowing fires in agency-built rings only	2.1	6.3	568	2.1	6.2	561
If the Forest Service were to conduct controlled burns to reduce vegetation and decrease the likelihood of large, uncontrolled fires	2.2	6.2	590	1.9	6.3	585
If the Forest Service were to reduce fuels by chipping or other mechanical means	2.4	5.7	532	2.3	5.6	505
If the Forest Service were to ban mechanically based uses on forest lands or areas of forests during fire season, such as off-road vehicle use or mountain biking	2.6	5.3	576	2.4	5.3	570

[a] Scale was 1=strongly disapprove, 8=strongly approve

[b] Scale was 1=would not be effective, 8=highly effective

Table 6.—*Results of Principal Components Analysis with varimax rotation*

Item	Component 1	2	3	4
Approve: controlled burns	.100	<.001	<.001	.915
Effectiveness: controlled burns	<.001	.104	.105	.911
Approve: ban uses on forest lands	.826	<.001	.114	<.001
Effectiveness: ban uses on forest lands	.775	<.001	.212	<.001
Approve: restrict uses of land	.411	.535	.199	.222
Effectiveness: restrict uses of land	.374	.601	.238	.194
Approve: signs at recreation sites	<.001	.787	<.001	.103
Effectiveness: signs at recreation sites	<.001	.747	<.001	<.001
Approve: close some areas	.756	.232	<.001	<.001
Effectiveness: close some areas	.714	.364	<.001	<.001
Approve: reduce fuels mechanically	.145	.128	.921	.144
Effectiveness: reduce fuels mechanically	.170	<.001	.933	<.001
Sum of Squared Loadings	2.739	2.053	1.896	1.813
Percent of Variance	22.823	17.106	15.798	15.105
Total Percent of Variance	22.823	39.929	55.727	70.833

Predicting Ratings of Interventions

A series of four regression analyses exploring the ability to predict the intervention ratings was conducted. For these purposes, only the respondents answering all three of the questions (values, goals or overall trust) going into the trust scale were included. The resulting number of responses was 489, with 9.9 percent of the original 606 lost due to missing on one of the three items, 7.4 percent missing on two out of the three, and 1.9 percent missing on all three items. Selection of the independent variables was based on a series of trust inquiries conducted by the author and her colleagues (Cvetkovich and Winter 2003, Winter and Cvetkovich 2000, Winter and Knap 2001, Winter *et al.* 1999).

The score reflecting the mean of effectiveness and approval ratings of banning uses and closing areas was predicted by trust, gender, concern, and knowledge about wildland and wilderness fires (table 7). The predictor variables accounted for approximately 10 percent of the variance in these two recreation–based interventions

Table 7.—*Summary of simultaneous regression analyses*

Dependent variable	Independent variables	*B*	*t*	sr^2
Banning some uses and closures of some recreation areas (n=486)				
	Trust	.238	5.191***	.049
	Gender	.131	2.987**	.017
	Concern	.086	1.876	.007
	Knowledge	.041	.952	.002
Signs and restrictions on some uses in recreation settings (n=486)				
	Trust	.271	6.051***	.065
	Gender	.141	3.275**	.019
	Concern	.102	2.289*	.009
	Knowledge	.084	1.982*	.007
Mechanical treatments, for example chipping (n=449)				
	Trust	.259	5.548***	.060
	Gender	.033	.742	.001
	Concern	.168	3.602***	.025
	Knowledge	.102	2.306*	.010
Controlled burns (n=483)				
	Trust	.180	3.894***	.028
	Gender	-.057	-1.281	.003
	Concern	.043	.930	.002
	Knowledge	.243	5.587***	.059

* = significant at $p < .05$; ** = significant at $p < .01$; *** significant at $p < .001$

($R^{2\,adj.} = .102$, $F(4, 43.717) = 14.745$, $p < .001$). Trust and gender were significant contributors to the regression equation; trust was the strongest predictor of ratings of bans and closures ($sr^2 = .05$). Those with higher ratings were more trusting of the Forest Service and were more likely to be female.

The second regression examined the ability to predict the effectiveness and approval ratings of use of information signs and restrictions on some uses in recreation settings, using the predictors of trust, gender, concern, and knowledge. The ANOVA was significant, with approximately 14 percent of the variance accounted for ($R^{2\,adj.} = .138$, $F(4, 31.932) = 20.401$, $p < .001$). Trust, gender, concern, and knowledge were significant contributors to the prediction of ratings of use of informational signs and restrictions on some uses in recreation settings, with trust being the most valuable of the four items ($sr^2 = .07$). Those with higher ratings of information signs and restrictions were more trusting of the Forest Service, were more likely to be female, were more concerned about fires, and knew more about fires and fire management.

The third regression explored the ability to predict ratings on mechanical interventions such as chipping. The resulting ANOVA was significant, with approximately 13 percent of the variance accounted for ($R^{2\,adj.} = .129$, $F(4, 75.977) = 17.637$, $p < .001$). In this case, trust, concern, and knowledge were significant contributors to the regression equation, with trust contributing the most to the understanding of mechanical intervention ratings ($sr^2 = .06$). Those with higher ratings were more trusting of the Forest Service, were more concerned about wildland and wilderness fires, and knew more about fires.

The final regression explored the ability to predict ratings on controlled burns. Trust, concern, gender, and knowledge accounted for about 9 percent of the variance in ratings of controlled burns ($R^{2\,adj.} = .091$, $F(4, 44.212) = 13.044$, $p < .001$). Trust and knowledge were significant contributors to the regression equation, with knowledge contributing the most to the understanding of ratings about controlled burns ($sr^2 = .06$). Higher ratings of controlled burns were associated with greater trust in the Forest Service and with more knowledge about fires.

DISCUSSION AND CONCLUSIONS

Attitudes and opinions about fire and fire management in wildland and wilderness areas vary considerably among California residents. Results of the present study indicate that people are fairly concerned about fires in the state. Trust in the Forest Service to manage fires on forest lands was fairly high, as indicated by measures derived from the shared values similarity model. Most respondents agreed that some fires have to be allowed to burn, but that residences should be protected. Agreement by the majority for a series of attitudinal and perceptual statements was found, although respondents were more likely to find the statement "controlled burns are likely to burn up more area than planned" as false. Greater support through average approval ratings was found for signs at recreation sites, seasonal closures, restrictions on use, and controlled burns. Less support was indicated for mechanical interventions and bans on mechanically based recreational uses of forest lands.

Regression results suggest that trust is the most important predictor of ratings of three of the four interventions. Ratings of controlled burns was the one exception, wherein knowledge was revealed as the most significant contributor to the regression equation. Although the amount of variance accounted for was somewhat lower than hoped for, each of the regressions was significant. The variability in the ratings, including the selection of more extreme scores on the negative ends of the scale reflects the diversity of public opinion. Work by Siegrist and Cvetkovich (2000) suggests that trust and knowledge are interlinked in such a way that greater knowledge results in lesser influences of trust in perceptions of risk. Although not explored in this paper, the interaction between knowledge and trust may have accounted for some of the variance left unexplained.

Establishing and maintaining trust with the public regarding fire management needs to be a central focus of managing agencies' efforts. Winter, Vogt, and Fried's (2002) work offers a valuable starting point for some of the bases of trust in fire management. This study suggests in addition that value comparisons and perceived similarity will be an important determinant of how individuals react to fire management policies and actions. Further, results suggest that knowledge is an important consideration in reactions to fire management issues, affirming the value of educating the public about fire issues.

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A collection of papers presented at the Ninth International Symposium on Society and Resource Management highlight research findings from studies supported by the National Fire Plan. These studies focus on the human dimensions of wildfire, and look at the perceptions and actions of individuals, homeowners, and communities as they try to make sense of, live with, and be proactive about wildfire management.

KEY WORDS: forest fire, wildland-urban interface,defensible space, fuel mitigation, wildfire management.

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